Multiprocessor Architecture: How It Breaks Bottlenecks

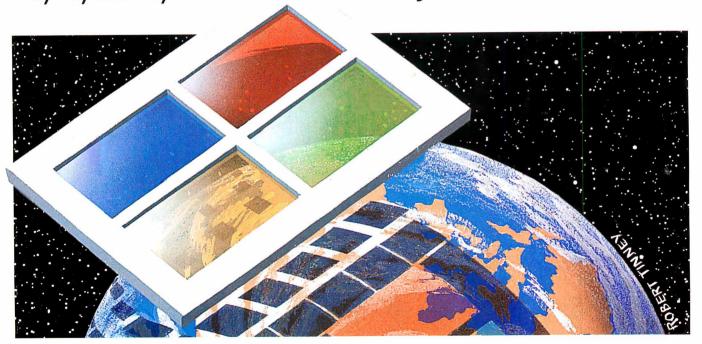
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New Lotus 1-2-3 for Windows

THE WORLDWIDE COMPUTING AUTHORITY

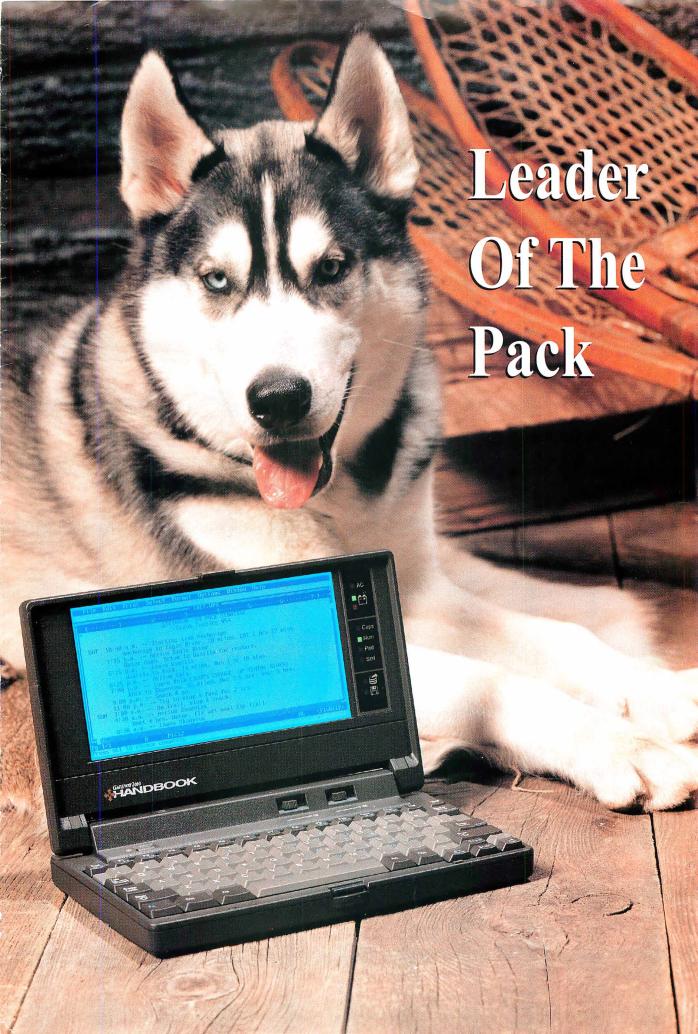
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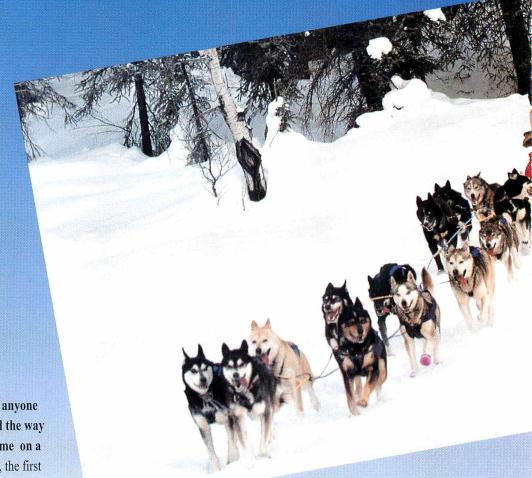


OS/2 2.1 IBM's Impressive Upgrade

ist of rver Technology



Gateway 2000's HandBook Is The Fire To Go The Distance!



It was the first time anyone ever took a portable all the way from Anchorage to Nome on a dogsled. Appropriately, the first portable PC to go the distance was the first product in an entirely new category of portables; the unique and innovative product that defined new standards for portable PCs: the HandBook, pioneered by Gateway 2000. At just 2.75 pounds, measuring only 6 x 10 inches yet including a 40MB hard drive, a backlit, use-it-anywhere screen and comfortable keyboard, the HandBook was the only choice for Iditarod musher Frank Teasley.

"I've always wanted a way to carry my racing strategy with me and to record my progress during the race," said Frank. "But I can't afford any extra weight on the dogsled, and you don't find many electrical outlets on the trail. The HandBook easily fit in the dogsled, and I used it at checkpoints to review details of

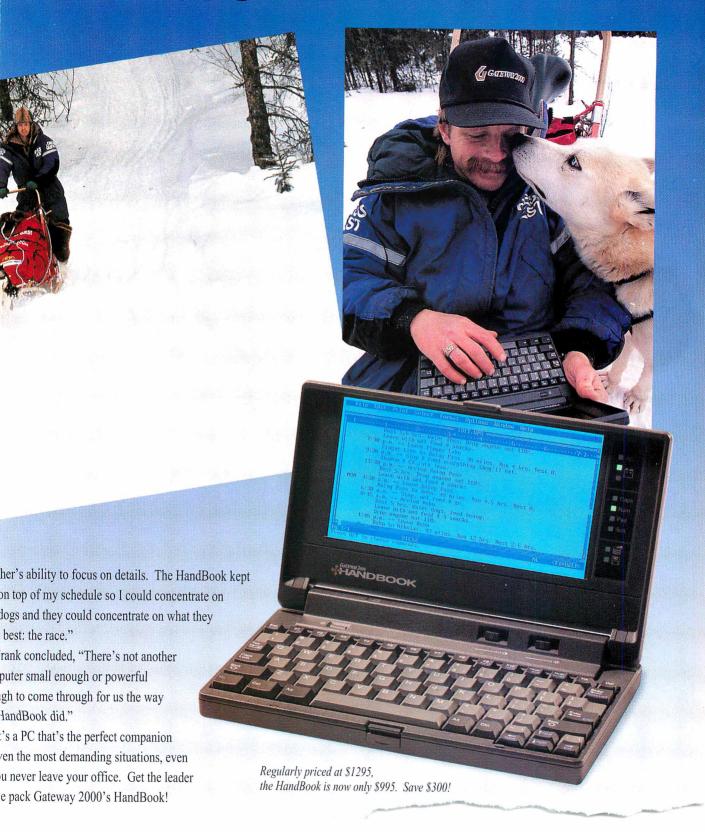
the trail ahead, information on my competition, and notes on my dogs." Because he couldn't recharge batteries on the trail, Frank ran his HandBook on AA batteries kept warm in his parka. th

lo

Frank said the HandBook's exclusive auto-resume feature was a big plus, too. Being able to open the HandBook and start working exactly where he left off made it effortless to use.

Although the dogs slept an average of 12 hours a day during the race, Frank was lucky to sleep 45 minutes daily. He was busy making straw beds, putting ointment on the dogs' feet, replacing their polar fleece booties, preparing their food, repairing harnesses and repacking while the dogs rested. "Sleep deprivation can be hazardous to a

st Portable PC



On March 6, 1993, 68 men and women, 1,253 dogs and one portable computer left the starting line in the 21st running of the Iditarod dogsled marathon. Not all of the men, women and dogs made it through nearly 1,100 miles of blinding snow, howling wind, mountainous terrain and sub-zero temperatures – but the HandBook did!

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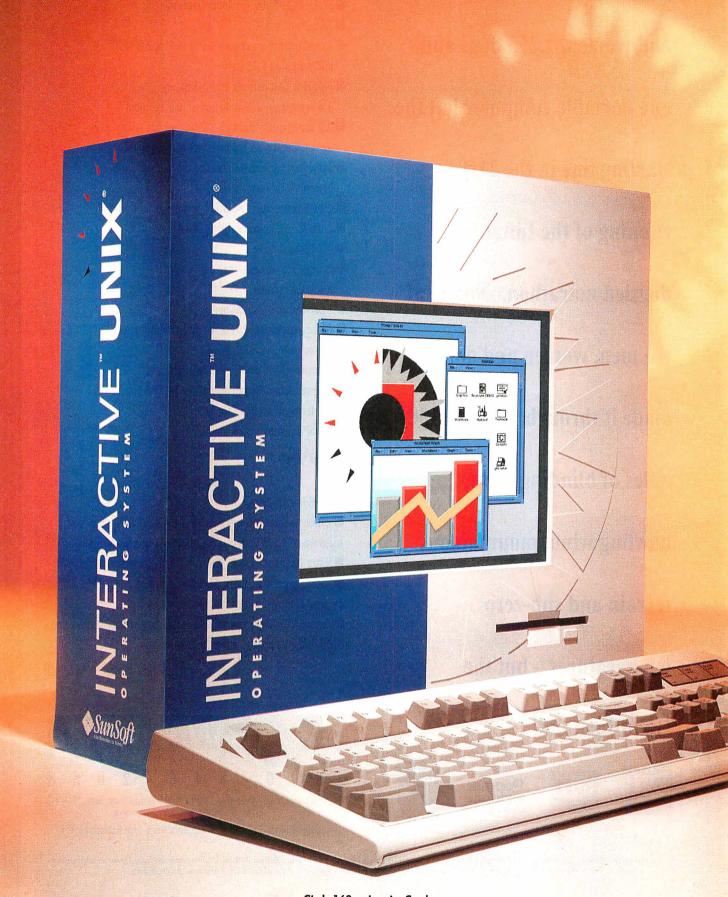






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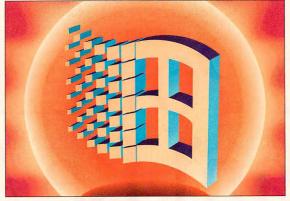
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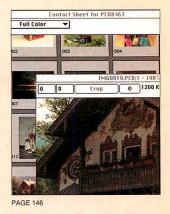
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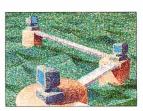




The Many Flavors of SQL

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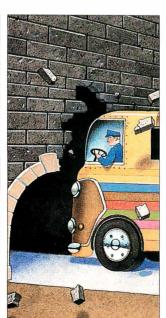
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PROGRAM LISTINGS

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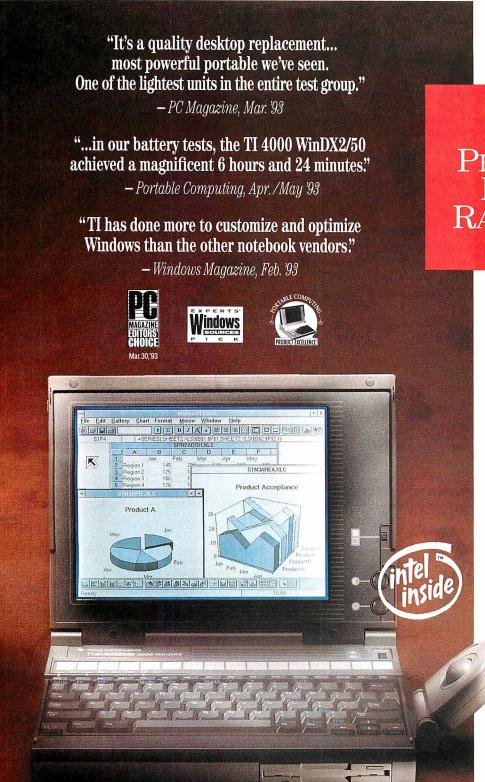
Middleware can help move data through a client/server network. It also gives a programming team standard APIs that can save development time.

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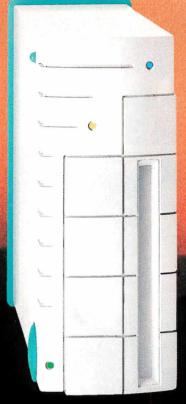


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Xcopy 50MB Tree to Optical Drive	379.5	1241.2	1047.9	492.7	1134.8		
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No, it's not your imagination—this issue of BYTE does look different, and there's a reason for the change. We've redesigned BYTE, and this new design is much more than a simple face-lift to make the pages pretty. Oh, I'll admit, the pages do look pretty, and that's a nice benefit. But the real reason for the change is to improve how BYTE delivers information to you.

The truth is, BYTE has not been very user friendly, and we knew we could do a better job. We needed some help, though, and it came from the two folks I mentioned last month: Richard Saul Wurman and Ken Silvia.

While Wurman stepped in primarily to help us with our new lab reports, his ideas influenced us in many ways. He helped us think like readers and not so much like editors. Sometimes editors forget what it's like to be a reader, and the result is that important information gets buried so deep in an article that you might miss it. Reading BYTE shouldn't be a game of hide-and-seek, so we've made important information obvious. Silvia, our magazine designer, deserves most of the credit. He created the framework that makes it all possible.

The idea is simple: We want to help each BYTE reader find his or her "personal pathway" through BYTE. It all starts with the table of contents. We learned that some people want to read a particular type of article first—review, cover story, feature, or column. So we've organized the table of contents first by section. For readers who are more interested in a particular application, we've added labels to the table of contents to tell you which articles are about spreadsheets, CAD, program development, or whatever application.

We've also included listings and page numbers for individual products in group reviews and for the many text boxes used inside larger articles. For those of you who want to read about specific platforms, we've added a third page to our table of contents that recategorizes major articles by platforms.

The articles themselves are more lively and contain more information than before. (One of the great advantages of our new design is that we're able to fit more words on a page.) BYTE's editors worked hard to break stories down into logical pieces and, whenever possible, to break those pieces down even further. So you'll see more text boxes and diagrams than ever before. You'll also see a greater use of call-outs and pointers in photos and screen shots to better explain the nuts and bolts of what's happening.

Many articles also have expanded "decks" to help you decide if the article is a must-read for you. If the subject matter is not for you, the deck will have provided you with some useful information, anyway. That's the whole idea—to help you decide which articles to read and to make important information jump off the page.

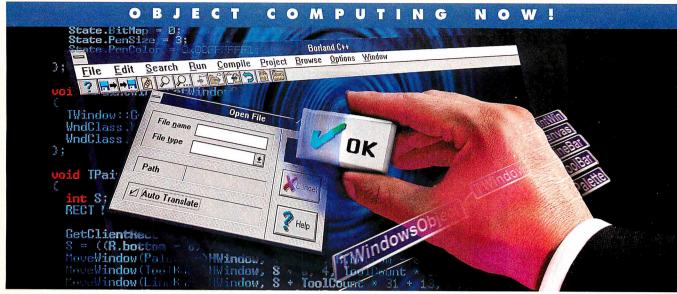
We've also changed our cover look to accommodate the issue-oriented nature of BYTE's cover stories. There you'll see art and photography play a lesser role than in the past. Instead, you'll see a bold headline with a descriptive deck to better convey what the story is all about. Still, we take the cover art very seriously, and that's why we commissioned Robert Tinney to illustrate this issue's cover. Many of you will remember when every BYTE cover was a Tinney illustration. While we'll still use photos and other illustrators, I'm particularly proud to have Tinney back for BYTE's new design debut.

Perhaps Tinney's art even serves as subtle notice that BYTE is getting back to its roots of being technically authoritative. It's a move that we began over a year ago, and one that you witnessed first in BYTE's cover stories. No other magazine has reverse-engineered low-cost PCs to tell you where manufacturers cut corners. No other magazine has done chip-level compatibility testing to help you decide whether a system really has to have an Intel chip inside. No other magazine has explained the technologies of CD-ROM, smart E-mail, and local-bus architectures at the level of detail as that in BYTE's cover stories. And while marketing-oriented magazines recently touted on their covers why you *must* buy MS-DOS 6, BYTE instead told you how to deal with the more immediate problem of fatware.

You can expect to see more and more of these kinds of stories. And expect to see greater technical depth as BYTE moves closer to its roots of being technically authoritative. Just don't expect BYTE to be dry and boring.

Meanwhile, let me know what you think about the changes.

Dennis Allen, Editor in Chief



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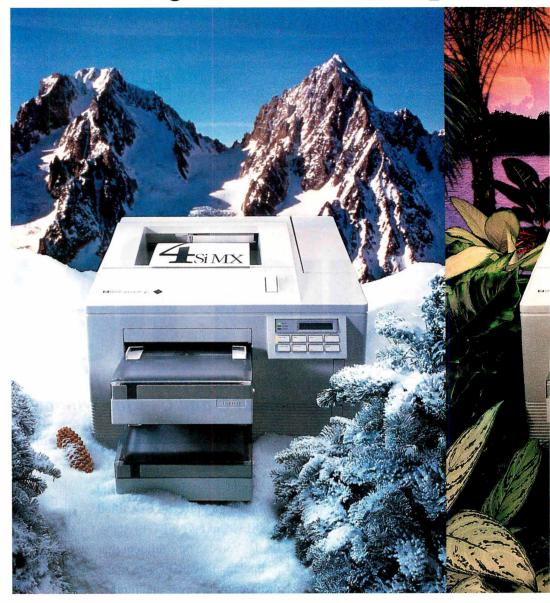
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Announcing the first network printer



Operating System	Topology
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LAN Manager	Token Ring (4/16Mbps)
Windows for	*802.3
Workgroups	Token Ring (4/16 Mbps)
WindowsNT	*802.3
	Token Ring (4/16 Mbps)
IBM LAN Server	*802.3
	Token Ring (4/16 Mbps)
AppleTalk	*LocalTalk
13.5	*EtherTalk
HP-UX**	*Ethernet
$SunOS^{**}$	*Ethernet
Solaris**	*Ethernet
SCO UNIX®	*Ethernet

*Standard in the HP LaserJet 4SI MX printer. **For operating HP-UX, SunOS or Solaris, a one-time purchase of \$199 in configuration software is required. Adobe and PostScript are trademarks of Adobe Systems Inc., which may be registered in certain jurisdictions. Microsoft is a U.S. registered trademark of Microsoft Corporation. UNIX is a registered trademark of UNIX System Laboratories Inc. in the U.S.A. and other countries, †In Canada call 1-800-387-3867, Ext. 7299. © 1993 Hewlett-Packard PE12353

Multiple environments are no longer worlds apart. Even if you have Novell Netware on one network, HP-UX on another and EtherTalk on a third, the new HP LaserJet 4Si MX printer easily connects across platforms. Automatically.

The HP LaserJet 4Si MX printer comes out-of-the-box preconfigured for multiple environments. There's nothing more to do than plug-and-play. All interfaces are simultaneously hot, making switching so seamless, end-users won't even notice.

What's more, HP's LaserJet 4Si MX printer is ready to handle whatever needs come down the

that adapts to multiple environments.



pike. More operating systems? No problem. As your network system continues to evolve, the capabilities of this printer are no longer just impressive. They're indispensable.

The HP LaserJet 4Si MX printer is loaded with features that define state-of-the-art. HP's enhanced PCL5 and genuine PostScript™ Level 2 software from Adobe™ come standard. Printer environments are saved while switching. Setup is a cinch with network software utilities and drivers included in the box. And, if you need any reassurance about trouble-free operation, you have it in our Simple Network Management Protocol (SNMP) support.

At 17 ppm, this is the fastest LaserJet ever, with I/Os and RISC-based formatter capabilities matched to support its speed. It delivers impeccable 600 dpi print quality—thanks to HP's microfine toner and Resolution Enhancement technology. Plus, it comes standard with two 500 sheet input trays.

But what if you don't need the full capabilities of the HP LaserJet 4Si MX printer right away? HP offers another printer that's probably a perfect fit. The HP LaserJet 4Si printer delivers the identical 17 ppm performance and superb 600 dpi print quality. It also has room to grow. The two MIO expansion slots let you add

HP JetDirect network interface or third party cards. And you can add on Adobe's genuine PostScript Level 2 software and SIMM memory modules, as you need them.

To find out more about the multiple-network HP LaserJet 4Si MX printer and the upgradable HP LaserJet 4Si printer just call 1-800-LASERJET, Ext. 7299.† Capabilities this advanced make a world of difference—in any environment.



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Los Angeles: 15635 Alton Pkwy., Suite 290, Irvine, CA 92718, (714) 753-8140.

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Smarter E-Mail

The article "Smarter E-Mail Is Coming" in the March issue was very interesting. The example of E-mail-based expense report-

ing was of particular interest to me. I had just returned from a trip and prepared and signed my expense report on a Monday. On Thursday, I was notified via E-mail that within two working days the reimbursement would be deposited in my checking account.

We use a spreadsheet to prepare the expense report and print it. However, the report

must be signed by the individual and a manager for payment to happen, and the appropriate receipts must be attached. Receipts are verified against what is listed. This has not yet been worked out for electronic means.

In your example, you had checks written. What happened to direct deposit? Let's go all the way.

> Fred Stone Orlando, FL

Please forgive my lack of knowledge, but in "Smarter E-Mail Is Coming," does the acronym API stand for application programming interface? This was a little amusing to me, because the sentence before the one that contained API referred to the "confusing alphabet soup of E-mail acronyms."

Perhaps for us novices, you should include a glossary in the back of the magazine of the more common acronyms not defined in the articles.

Bruce J. Benedict Lynchburg, VA

"Application programming interface" is correct.—Eds.

A Taxing Review

Your cover proclaims BYTE to be "The Worldwide Computing Authority," and the March editorial mentions BYTE's recent "globalization." Given that, shouldn't your recent article on tax-preparation software ("How to Deal with Taxing Questions," March) have been described as "U.S. tax-preparation software for DOS, Windows, and the Macintosh"?

> Paul Clapham Vancouver, British Columbia, Canada

Computing in Italy

I was pleased to read "Computers Italian Style" (February). We have little software in the major applications areas. This is sure-

> ly connected with having many small companies and few medium and large ones in the field.

> As for piracy, it's here, and it's here to stay. A lot of users simply don't think computer programmers have to eat! The Business Software Association is doing a good job, but the real problem is that we lacked a law on software piracy until last December. Almost every European country

had such laws long before Italy. On the other hand, "miracle" laws don't exist, so we must work harder to defeat pirates.

> Daniele Russo Catania, Italy

Faster Macs

Rick Grehan's accelerator-board roundup ("New Tricks for Slow Macs," February) offered a promising introduction to accel-

erator-board upgrades, but it includes misinformation regarding available options. Extreme Systems submitted its Impact 030 (for the Mac LC, Mac LC II, and Performa 400) and the 50-MHz Vandal (for the Mac SE). The Vandal, which offers substantial speed increases and large-screen video support, was omitted from the review. Installing Vandal would have

caused Mr. Grehan to rethink his statement that "installation [of accelerator boards] can be an ordeal."

While the author brought up pertinent issues surrounding accelerator boards, he neglected to address power consumption. Excessive power consumption can wreak havoc, particularly on Mac LC and LC II systems. Apple's guidelines for the LC and LC II specify no more than 4 W.

The author recommended only one accelerator board. This is rather limiting, since the article discusses accelerator-board options for several Mac platforms. A recommendation for each category would have been more appropriate.

> Steve Snyder Director of Sales and Marketing Extreme Systems Tukwila, WA

We'd like to test every version of every accelerator board, but time and space considerations make that impossible. Perhaps in a later review we'll have the opportunity to examine the 50-MHz version of Vandal. The version of Vandal we did test didn't end up in our recommendations, but it did perform well overall.

My comments in the Action Summary "Dislikes" section may not have been clear. My point is that installing any board inside a Mac SE, Plus, or Classic is an ordeal. The difficulty in doing so is a function of the computer's construction, not of the accelerator-board de-

Your recommendation on adding power requirements is a good one. Thanks for your input.—Rick Grehan

Windows Bias

I am unhappy with the editorial policy outlined by Dennis Allen (see "The State of BYTE," March). I believe that you are demonstrating an excessive and uninteresting focus on Microsoft products, par-

ticularly Windows.

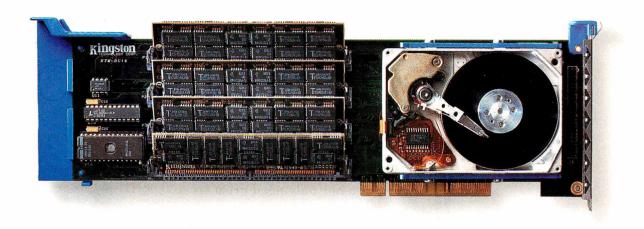
I use Macintosh, DOS, and OS/2 products extensively. I am interested in PenPoint, GEOS, Solaris, and even Windows NT, in moderation.

If I want to read about Windows, I can pick up any one of dozens of periodicals. I am not looking forward to two special Windows issues. Please reconsider your decision.

> John Faughnan Escanaba, MI

I appreciate your comments on this issue. Our Windows issues are extra issues—they are not part of our regular monthly editorial schedule—that allow BYTE to quickly cover this exploding market. It has never been our intent to focus BYTE's regular issues exclusively on Windows. BYTE will continue to cover a wide spectrum of computing platforms.—Dennis Allen

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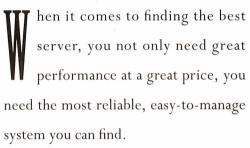


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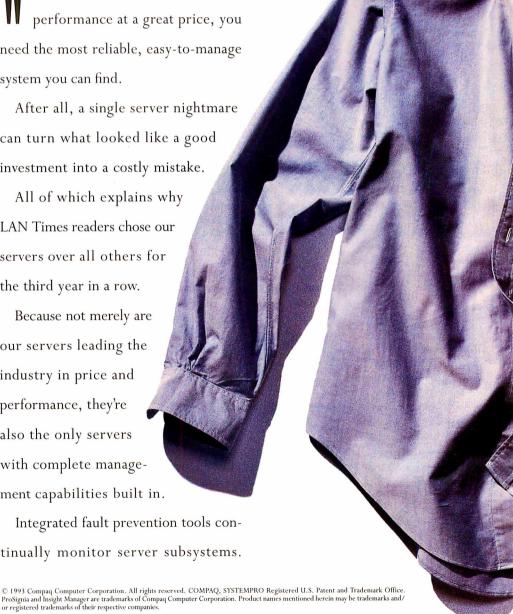
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A-B7 Gasteiner

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Data Entry / Phone log / Customers / Analyses / Billables

Lotus 1-2-3 release 4 for Windows packs more punch than the previous version and should challenge Microsoft Excel

NICHOLAS JOHN DELONAS

otus 1-2-3 release 4 for Windows (\$495) is a major upgrade that, based on the prerelease software I

evaluated, may help Lotus 1-2-3 make up ground on Microsoft Excel, which now dominates the Windows spreadsheet market. Even though many of the improvements are features that should have been there in the first place, Lotus 1-2-3 release 4 for Windows isn't merely a catch-up product. It offers several outstanding capabilities that you won't find in other spreadsheets.

The most interesting new feature is Version Manager, which lets users and groups of users store different versions of a worksheet in the same file. The capabilities introduced in the Version Manager dialog box are exciting. In fact, Version Manager alone might justify choosing 1-2-3 over Excel or Quattro Pro for Windows. (See the

NEW FEATURES

- Version Manager
- In-cell editing
- Live Status Bar
- Support for OLE and ODBC
- Easy access to external data

text box "Infinite What-If Scenarios" for a more detailed look at Version Manager.)

When it comes to matching the major features found in Excel and Quattro Pro for Windows, release 4 does a good job. Lotus 1-2-3 now feels more like a real Windows application, and less like a product that was quickly ported from DOS. For example, you can select whole

(617)782-5008

columns and rows by clicking on the worksheet frame. There's also a draw layer that lets you add arrows, lines, and so on over the worksheet and any embedded graphical objects. A click of the left mouse button selects any such object or a range of cells. A click of the right mouse button pops up a short-menu dialog box, letting you make quick changes appropriate to your current selection.

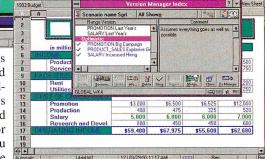
The new release for Windows also offers in-cell editing, drag-and-drop capability, one-step charting, on-the-sheet

chart editing, and a great "live" status bar (similar to the one found in Ami Pro) at the bottom of the screen that shows the current status of highlighted cells. In short, release 4 feels like it was meant to be a graphical spreadsheet.

Help for Macro Writers

Release 4 lets you add macro buttons to the worksheet, and you can choose from 250 new macro commands. Lotus has also added 110 new calendar, database, engineering, financial, logical, informational, lookup, mathematical, and statistical @functions. Lotus 1-2-3 now supports both client and server OLE and the ODBC

Compatibility with 1-2-3 for DOS worksheet models is better than before, although it's still not perfect. Adding named pages and a few macro buttons can spice up your old models.



Options

Version Manager let me switch with ease between pessimistic and optimistic forecasts in this projected income statement.

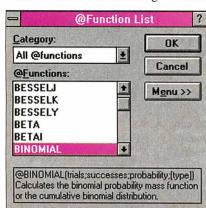
(Open Database Connectivity) standard, which makes it easier for it to work with other applications.

For less-experienced users, many new features make release 4 accessible. Menus, SmartIcons, and dialog boxes are more context-sensitive than in the previous release, and there's even an animated online tutorial.

Have you forgotten the name of an @function or the

order of the arguments? No problem. Just click on the @function SmartIcon to select from a pull-down list.

Have trouble understanding



The @function Smartlcon displays a dialog box that lets you peruse a list of @functions. Once one is selected, Lotus 1-2-3 release 4 for Windows walks you through the entry of the @function's arguments.

1-2-3's 3-D architecture? Take a look at what may be the best new ease-of-use featureworksheet tabs. These tabs are analogous to the tabs you find in a file cabinet. They let you navigate between worksheets intuitively and assign meaningful names to those sheets, so you can easily see where you're going. Unfortunately, you can't drag and drop whole sheets, as you can in Quattro Pro for Windows. Even so, the new tabs are a welcome addition to 1-2-3.

Lotus 1-2-3 for Windows

has always had more powerful database features than Excel or Ouattro Pro, and now these features are also easier to use. There's no longer any need to

> create a criteria range in the spreadsheet. Instead, you specify criteria via simple dialog boxes. The process of connecting to external data is much easier than before. There's still one glaring deficiency, though: the lack of an external data browser.

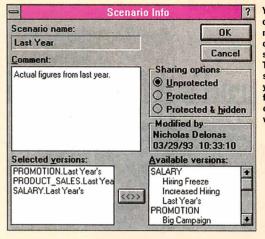
The Big Picture

Other new features in release 4 include more

flexible print compression to let you fit more of your spreadsheet on a single page, a spelling checker, mail-enabling capabilities, spiffy designer frames for boxing data, and a new file format (.WK4) to hold all these features in a single file. Although it's risky making recommendations based on beta software, Lotus 1-2-3 release 4 for Windows looks like a clear winner that should excel in the Windows spreadsheet market.

Lotus Development Corp. 55 Cambridge Pkwy. Cambridge, MA 02142 (800) 343-5414 (617) 577-8500

INFINITE WHAT-IF SCENARIOS



You can create any number of complex scenarios. To create a scenario vou select from the list of available versions.

The idea behind Version Manager is simple enough. A version is a named data set that you can bring into a worksheet range as needed. For example, suppose you have a range named "revenues" that holds projected gross income for the coming year. You could enter one set of pessimistic data and name it "Pessimistic." Then you could enter optimistic data and name it "Optimistic." To switch between versions, you need only call up Version Manager and select the data set you want from a pull-down list.

Version Manager is great for what-if analyses and testing various scenarios. Better yet, Version Manager can manage the shared use of a single worksheet file. For example, a workgroup might work on a single budgeting model. Lotus 1-2-3 automatically stores each person's contribution as a time-stamped version and keeps track of who contributes what by storing each user's ID with that version. This eliminates the need to roll up data from various departments. To provide security, Version Manager automatically searches for the most authenticated name and ID (for Notes, cc:Mail, network log-on, or user sup-

Finally, Version Manager lets you combine any number of versions into scenarios. For example, you might create a scenario called "Best Possible," which would include best-case versions of both revenues and expenses. This approach is definitely easier than Excel's Scenario Manager, and it's more powerful, too.

PRODUCT WATCH

Lotus Notes: The Next 1-2-3?

y the time you read this, Lotus should have released Notes 3.0, which the company hopes will do for groupware what Lotus 1-2-3 did for spreadsheets. The new Windows version of 1-2-3 could help Lotus improve its market share in the Windows spreadsheet category, which analysts say is currently dominated by Microsoft Excel for Windows. But Lotus officials admit that the spreadsheet category is a more mature market than that of groupware, thus offering less opportunity for growth. "In some of the more mature product areas, you'll do feature-leaping," Brenda Kelly, product marketing manager for Notes, says. "In a category such as Notes or groupware, what you're really doing is helping people understand the value,

the return on investment."

To help get the word out on Notes 3.0, Lotus created the Notes Open Education Program to expand the availability of Notes application development, installation, and administration training. Fifteen independent Notes training centers are scheduled to open in the U.S. this summer, with an equal number slated to open in Europe.

At the Notes 3.0 rollout, Lotus officials said that where 1-2-3 was the strategic product for the company in the 1980s, Notes will be its strategic product in the 1990s. Unlike 1-2-3, which was an instant money-maker, Notes, which was first introduced in 1989, has not yet generated a profit as a product.

— Dave Andrews and Dom Pancucci

NOTES 3.0

- Support for Mac, OS/2, and Windows clients
- Notes Server for Windows
- Remote administration
- Integration with 1-2-3 for Windows release 4's Version Manager
- Support for OLE
- Relational database queries from within Notes
- Support for Mac AppleTalk, OS/2 AppleTalk, Novell IPX/SPX, TCP/IP. X.25 Connect, IBM SNA, DECnet Pathworks, NetBIOS, and Vines
- Unix client and server, NetWare server due by the end of the year
- Windows NT version for Intel PCs in 1993 or 1994

LONDON

Amstrad's Affordable Pen Package



The Pen Pad weighs less than a pound and is solely penoperated, with no external (or emulated) keyboard option.

U.K. computer maker Amstrad showed its Pen Pad PDA600, a PDA (Personal Digital Assistant) that may beat Apple's Newton, Tandy/Casio's Zoomer, and others to the punch by many months, and possibly by many dollars. The Pen Pad should now be on sale in the U.K. and worldwide for £299. Although no dollar price was

announced, Amstrad's chairman Alan Sugar suggested that \$399 was the price he'd like to see.

The Pen Pad runs proprietary operating-system software developed by Amstrad and the Eden Group, the U.K. electronics firm that also designed the hardware. An intuitive user interface is based on a Filofax page metaphor, which is similar to PenPoint from Go Corp., where you select functions with the pen by

touching 12 icons around the page border. No menus are used. The software supports English, Spanish, German, French, and Italian.

Built-in applications are an address book and phone dialer, a diary/time manager, a to-do list, a world clock, a calculator, a scribble notepad, and a unit converter that supports

both built-in and user-defined functions. All applications except the notepad recognize handwritten characters for input, although you must enter characters singly into boxes. When you switch

on the Pen Pad, you train the character recognizer by writing out the alphabet. You can also retrain individual characters on the spot whenever a misrecognition occurs. Only one person's handwriting library can be stored at a time, lending a literal sense to the word *Personal* in PDA.

Rather than adopting a 32-bit RISC CPU, Amstrad/Eden has opted for a less-expensive but effective approach. The Pen Pad employs three 8-bit microcontrollers (Z80-compatible, mask-ROM devices from Siemens) as CPUs: one devoted to power management, one to character recognition, and one to data processing. Applications programmers will write to a function-call API that hides the details of this multiprocessing.

Amstrad is aiming the Pen Pad at the lower end of the PDA market. Sugar acknowledged that his competitors will soon offer higher-tech PDAs with built-in radio communications and other features that the Pen Pad lacks. But the affordable Pen Pad is here now, and it works.

—Dick Pountain

UPDATE



HP 100LX Computer

Hewlett-Packard recently updated its two-year-old HP 95LX hand-held computer with a new PC-compatible palmtop computer, the HP 100LX (\$749). While the new system features an improved screen and new or improved bundled applications—most notably Lotus's cc:Mail and a graphical PIM (personal information manager) written by HP—it sports the same form factor as the 95LX.

The 11-ounce 100LX has MS-DOS 5.0 in ROM. It bundles Lotus 1-2-3 release 2.4. The 100LX uses an Intel 7.91-MHz 80C186 microprocessor, which HP says offers 50 percent more speed than its predecessor. The 100LX's new screen has an enhanced 80-column by 25-row, CGA-compatible LCD with a zoom feature that lets you see the entire document page viewable on a desktop PC.

The 100LX features a new PCMCIA 2.0 plug-in slot for adding flash-memory cards or modems.

—Patrick Waurzyniak

THE FACTS

- 128 KB of nonvolatile memory; enough to hold 5000 phone book entries
- Level 1 PCMCIA slot; expand memory to 2 MB or add new ROM-based applications
- Estimated 40-hour battery life from three AA cells

HANNOVER, GERMANY

Apple's Newton Will Debut This Summer

Apple's Gaston Bastiaens bets his wine cellar on the Newton's shipping this summer.



t the CeBIT computer show, Apple Computer announced that its long-awaited PDA will be available this summer. When asked whether this projected delivery date would be more realistic than Apple's previous estimates, Gaston Bastiaens, general manager of Apple's PIE (Personal Interactive Electronics) Division, said, "I bet my wine cellar on this, and it's a great wine cellar."

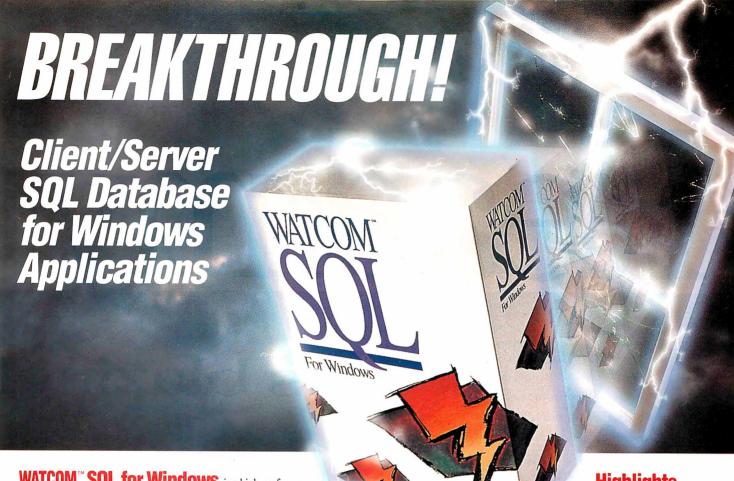
Apple's Newton will be but the first of a family of similar devices with varying sizes and capabilities available from several vendors. German electronics giant Siemens AG announced a version of the Newton called Notephone, which will include a cellular telephone and a fax/data
modem. Matsushita, Sharp, and Motorola announced that they
would also offer Newton devices.

Apple sees a range of Newtons with various sizes of LCD screens. The products include an educational toy, a small "inventory watch" worn like a wristwatch.

ucts include an educational toy, a small "inventory watch" worn like a wristwatch, and an architect's sketch pad with a large screen. Apple says the wide range of possibilities is due to the low cost of the Newton's processor, the ARM610.

— Rich Malloy





WATCOM SQL for Windows is a high-performance SQL database engine for Windows applications. The package includes everything required to begin using WATCOM SQL immediately from many popular Windows applications, supporting interfaces ranging from ODBC and DDE to the Windows clipboard. Everything necessary for application development in C/C++ (using compilers from WATCOM, Microsoft or Borland) is also included.

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EDITORS CHOICE

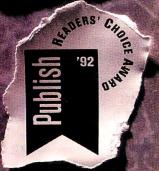
overall performance with a true optical resolution of 400 dots per inch, an excellent scanning software package (DeskScan II), and HP's well-earned reputation for solid, reliable products, and you have a winning combination.

It's blazingl

THE BEST HARDWARE & SOFTWARE OF THE YEAR PC Magazine Labs' te ference between the every test. In line-art the HP ScanJet IIc seconds, while five 115 seconds or more

In general, you twice as long for a conscale. With a fast scalar translate into a half a ner, the set up to color more.

...top scoring product...



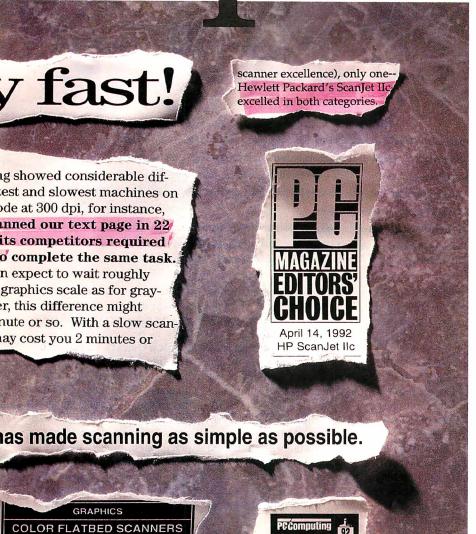
SUPERIOR PERFORMANCE

The ScanJet IIc performed well during all phases of PC Magazine Labs' testing. In terms of speed, this scanner led the field, ranking first in two of five speed trials and best overall. Some scanners,

as a whole, and a street price as low as \$1,450, and it's hard to imagine a better buy.

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far to make the ScanJet IIc an

application.



HP ScanJet IIc



HP ScanJet IIp

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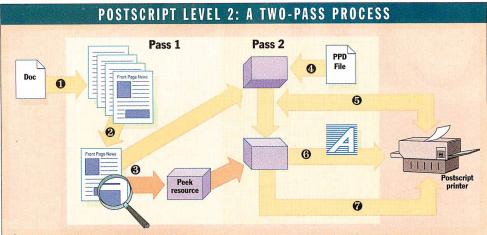


PRINTERS

PostScript Level 2: Adobe Takes the Driver's Seat

ostScript Level 2 promises better memory management, more efficient (i.e., faster) operators, a pattern generator, and device-independent color support. The enhanced PostScript was introduced in 1990, and since then, numerous printers equipped with PostScript Level 2 interpreters have appeared on the market. However, they have not been able to reap the speed benefits of the new interpreter because a crucial component was missing from the printing process: There wasn't a Level 2 driver for the computers. Because PostScript Level 2 is a superset of the original PostScript language, the Level 2 printers worked fine with Level 1 drivers. Still, many printer owners probably wondered what the value of PostScript Level 2 was.

In April, Adobe finally released PostScript Level 2 drivers for both Macs and Windows. The reason for the delay was compatibility with existing software. On the Mac, some applications routinely made im-



- ① The document is spooled to the disk. Each page is imaged as a separate QuickDraw picture.
- @ Page components are determined. Components include images, typefaces, patterns, and bounding boxes.
- 19 "Peek" resources—or tokenized objects—are created to optimize code during the second pass.
- PPD files supply printer-specific information to the job, such as printer resolution and image enhancement.
- **6** The printer is queried for available typefaces.
- (3) Portions of the job header are sent for image/graphics support; required fonts are downloaded.
- QuickDraw page images are converted to PostScript. Peek resources are used to perform code optimizations. ASCII and binary data compression are performed before the page is sent to the printer.

proper or redundant calls to the driver. Adobe and Apple have fine-tuned the driver to operate with these "print felons."

I tested two prerelease versions of the Mac PostScript Level 2 driver. The software consists of a Chooser-selec-

table driver and a host of PPD (PostScript Printer Description) files. These PPD files contain device-specific information that the printer driver uses to optimize the Post-Script code during printing.

I installed the driver on a Mac IIci using a DayStar Digital Turbo 040 accelerator board, a Quadra 950, and a Centris 650. The driver worked without problems with Claris MacWrite II, Microsoft Word 5.1, Aldus PageMaker 4.2,

Adobe Photoshop 2.5, Adobe Illustrator 3.2, Think C 5.0.4, Jasik Designs' MacNosy 2.98Q, and Zedcor's FutureBasic 1.04.

To see if the driver boosted performance, I timed how long it took to print several types of documents in the background to an Apple LaserWriter IIg and a Tektronix Phaser IISD color dye-sublimation printer. The host Mac was connected to the printer via a single, thin Ethernet cable, which eliminated network traffic. Overall, small jobs showed only a small time difference between the drivers. Bigger jobs produced bigger time savings. This is because the driver uses two passes to produce efficient code and compress image data. For binary data, run-length encoding is used for image compression. Some network spoolers can choke on binary data, so when ASCII hexadecimal is used to send the file to the printer, ASCII-85 encoding is used.

The driver is actually slower when you print with the background printing switched off. This is because the driver spools a QuickDraw image to disk first. The driver uses this image to perform its optimizations and data compression. For this reason, you lose any boost when you switch off background printing, or you get cornered into printing in the foreground when your application swallows all available memory. A future version will optimize on the fly, Adobe says, but for now PSPrint is designed to work in the background. Based on the timing results, professionals making heavy use of color graphics and large image files stand to gain the most from PostScript Level 2.

—Tom Thompson

Adobe Systems, Inc., 1585 Charleston Rd., P.O. Box 7900, Mountain View, CA 94039, (415) 961-4400.

POSTSCRIPT LEVEL 2 PERFORMANCE

DRIVER	PS LEVEL 2	APPLE
Illustrator document	98	119
Four-page color document	395	657
10-page dummy article	669	778
Small Photoshop file	63	143
Large Photoshop file	304	948
Photoshop file (CMYK)	984	1699

Notes:

All times are in seconds based on beta versions 8.0b2c2 and 8.0b4c1.

The Illustrator file is 122 KB in size and uses a 24-bit graphic.

The four-page color document uses several color EPS files, several typefaces, and one 24-bit color scanned image.

The dummy article uses several gray-scale images and several typefaces.

The small Photoshop file is a 1.15-MB 24-bit image.

The large Photoshop file consists of an 11.3-MB 24-bit image. The CMYK file is a 15.1-MB 24-bit color Photoshop file printed to a Tek Phaser IISD.

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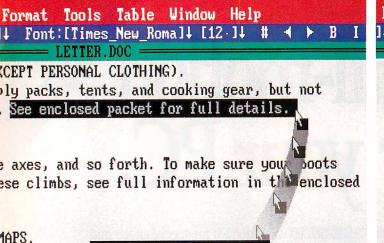






MacroMind

Action! for Windows.



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for sightseeing in addition to mountain Tools

Edit View

You may join the tour at any time (cost is broken down by cou we recommend that to get the most out of the experience, you the entire excursion. Exotic Excursions will take care of these

- ALL OUTDOOR GEAR (EXCEPT PERSONAL CLO For example, we supply packs, tents, and cooking gear, b rain gear. See enclosed packet for full details.
- ALL CLIMBING GEAR. Ropes, crampons, ice axes, and so forth. To make sure yo suitable for these climbs, see full information in the enclo
- LOCAL CURRENCY AND MAPS. All the maps you need, currency for the first day in any g Again, th **Automatic bullets**

addition to moun We've includ so plan to bring any clothing and spending money that you wil casual travel. We hope you can join us - it will be an adventure

AUGUST

View Tools

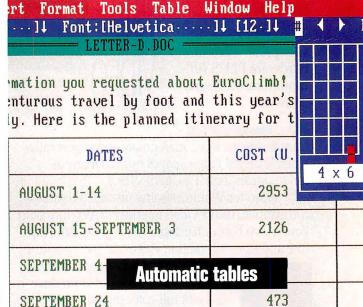
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6 Preparation	Lines and b	orders	9 Climb

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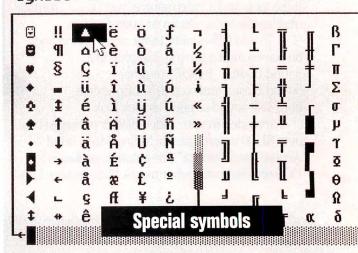
You may join the tour at any time (cost is l However, we recommend that to get the most you shou<u>ld sign up for the entire excursion</u> **One-step formatting** care of

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Projected Benefits of Energy Star

The U.S. Environmental Protection Agency's Energy Star program has expanded from last year's original eight member companies that promised to develop energyconserving computers to over 50 companies. This number is increasing on a weekly basis. Brian Johnson, the Energy Star program manager, says the EPA has added printer, system software, and monitor categories to the program. Companies can affix an Energy Star logo to products that can power down to 30 W when not in use. According to Johnson, a PC and monitor without a powerdown mode will draw about 150 W, or 1300 kilowatthours per year, if the system is never turned off.

The EPA estimates that without the Energy Star program, computer systems (including monitors and printers) will consume 70 billion kWh of energy by the year 2000. This assumes that 70 million PCs and workstations will be in use. The EPA estimates that if 65 percent of all printers, monitors, and CPUs are Energy Star-compliant by the year 2000, the reduction in air pollution due to the reduced energy needs will be equivalent to taking 5 million cars off the road annually. Energy savings per Energy Star unit is estimated at 57 percent. The base cost per kilowatt-hour is estimated by the EPA at 7.5 cents. These numbers are the official U.S. estimates derived from several government agencies, including the Department of Energy and the EPA.

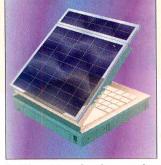
HANNOVER, GERMANY

Designing PCs That Age Gracefully

erman computer giant Siemens Nixdorf (+49 821 804 2949) announced a new desktop system that takes environmental friendliness beyond just conserving energy. In addition to a sleep mode in which power consumption drops to just 5 W, the PCD-4L can be largely recycled.

Siemens says that 95 percent of the PCD-4L (starts at 3845 deutsche marks) can be recycled. The company admits that recycling is not a priority item on most computer buyers' checklists, but it expects that many governments will soon pass laws that require businesses that sell products to recycle them for their customers.

To help companies design products that are more easily recycled, the Microelectronics and Computer Technology Corp., a research consortium in



Zenith's prototype of a solar-powered notebook.

Austin, Texas, recently organized a Life Cycle Environmental Study conference in Washington, D.C. Presenters at the conference suggested that manufacturers should make circuit boards that are expandable to new processors and develop monitors so that the screen can easily be separated from the yoke and recycled.

At CeBIT, Zenith Data Systems (Langen, Germany, +49 6103 761 733) showed a rough

prototype of a solar-powered notebook system. The system will not make batteries obsolete, but it will extend the duty cycle of batteries from 3 hours to 6, 9, or even 12 hours, company officials said. A group of engineers tiled the top of a Z-Note notebook with an array of indigo-blue solar cells. Because the notebook was too small to hold enough cells to generate the required amount of electricity, ZDS engineers added a 2-inch-wide strip of cells (see diagram). The cells will function in both sunlight and regular room lighting.

Company officials say that it will take 12 to 18 months before the solar-cell-equipped notebook is available. The extra price required by the cells is estimated at DM 1000–1500 (\$650–\$1000).

-Rich Malloy and Peter Wayner

Nanao's New Power-Saving Monitors

anao USA's new 17-inch FlexScan F550iW (\$1599) and 21-inch FlexScan F760iW (\$2999) typify a new generation of color monitors. These power-saving models consume 120 and 160 W, respectively, during operation. However, 3 minutes after your computer's screen saver activates, the monitors enter the first-stage Pow-



er Saver mode, where the power draw is cut to approximately 12 and 16 W, respectively. You can set the Power Saver mode to last anywhere from a few seconds to 60 minutes. When the monitor enters the second stage, the Power Down mode, power consumption drops to about 8.5 and 11.5 W, respectively. When in the Power Down mode, it takes about the same amount of time to wake the FlexScan as it does to cold-start the monitor.

One problem with these monitors is that the Power Down mode will not activate unless your screen saver is mostly black (e.g., a blank screen). Nanao ((310) 325-5202) is negotiating with companies like Berkeley Software to solve this problem.

-Gene Smarte

GOING GREEN:

EASIER SAID THAN DONE

- Percentage of employees within top U.K. companies that would like their offices to be environmentally friendly96

- Percentage of companies that use recycled paper for internal or external communications

Survey results from 304 executives, equipment purchasers, and office workers in a U.K. survey conducted by Network Research, an independent London-based market-research company.



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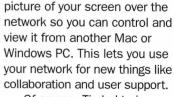
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GRAPHICS WORKSTATIONS

Going to Extremes

Silicon Graphics stretches its low end with the Indigo2

he Indigo2 completes Silicon Graphics' effort to replace the Personal Iris line. For about the same price that you would have paid for the top-of-the-line Personal Iris model in 1990, the Indigo2 gives you 10 times the CPU performance and 20 times the graphics performance, making it an ideal platform for data visualization.

While the Indigo2 is the newest system in Silicon Graphics' most popular line, the only similarity to earlier Indigo systems is the name. The shape, bus, and processors are not what you will find in any other Indigo workstations.

The most impressive element of the Indigo2 is its Extreme graphics processor. This uses eight geometry engines and two raster engines.

The geometry engines are specialized floating-point processors dedicated to resolving

the solids modeling and surface lighting of the objects that are being displayed in a window. The geometry engines are also responsible for shading and some of the more specialized effects (e.g., motion blur and fog). Each geometry engine can perform 32 MFLOPS. Because the work done by the geometry engine is easily vectorized on separate surfaces, parallel processing produces faster throughput.

The raster engines determine the location where each screen pixel will reside in the physical screen memory. Despite the fact that a pixel's position and attributes can be expressed as a set of integer values, the engines do their processing using floating-point numbers as well. This ensures smooth and accurate motion.

The Extreme board's high performance requires Silicon Graphics' wider GIO64 64-bit bus to facilitate high data transfer between main memory and the graphics processor and other data-hungry peripherals (e.g.,

the high-performance multichannel audio-processing system). The GIO64 bus is the main system bus connecting the processor core, main memory, the I/O system, and the graphics board (it resides in one of the Indigo2's three

GIO64/graphics slots).

The Indigo2 also has four 32-bit EISA slots running at 25 to 33 MHz. The EISA bus is fully implemented with its own bus controller, enhanced DMA functions and buffering, interrupt control, and clock. It is independent from the CPU bus and the GIO64 bus. This lets the processor core (i.e., the R4000), the Extreme graphics processor, and EISA devices each run independently at their most effective speed.

The Indigo2 that I tested had a 1-GB hard drive, 32 MB of RAM, the 50-MHz R4000 CPU, and an Extreme 24-bit

Commence Com

graphics board (it The teal-blue Indigo2 is far from attractive, but your eyes recides in one of will focus on the impressive graphics rendering on-screen.

color frame buffer and 24-bit z-buffer (1280- by 1024-pixel resolution) driving a 19-inch monitor. This is the base configuration (\$35,000).

You can order (or upgrade) your Indigo2 with a 75-MHz R4400. You get 50 percent higher performance for an extra \$6000.

Besides a faster clock, the R4400 gives you twice the onchip data and instruction cache space (16 KB). The R4000 is rated at 16 MFLOPS, and the R4400 is rated at 22 MFLOPS. A preliminary run of the BYTE Unix benchmarks showed that even the R4000 processor gave eight times the performance of a Sun SparcStation 1+.

The Indigo2 with its Extreme graphics subsystem is an ideal platform for running applications built with Silicon Graphics' object-oriented graphics libraries, Iris Inventor and ImageVision. The Indigo2 bridges the graphics performance between the systems with Elan boards and those with the high-end graphics engines such as Silicon Graphics' Reality Engine (\$99,000, not including the computer).

- Ben Smith

Silicon Graphics, Inc. 2011 North Shoreline Blvd. Mountain View, CA 94034 (415) 960-1980

EXPLORING DATA WITH VISUAL PROGRAMMING



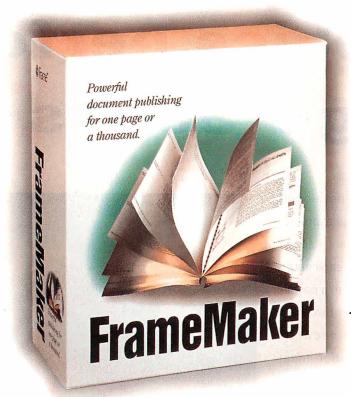
Iris Explorer's visual-programming interface is a simple way to take advantage of Silicon Graphics' rich data-visualization capabilities. You can rotate, walk through, and even fly through the virtual objects that represent your data. You can add color mapping, lighting, and surface characteristics to the data. Your data may not have any spacial characteristics of its own, but you can explore it as if it were an object in your hand.

Explorer is a graphical environment for manipulating and visualizing complex and large sets of data (see the "Visualization" State of the Art section in the April BYTE). You build the entire process of manipulating

and generating models from the data by tying together modules that run as separate processes on a single computer or even distributed over a network of computers. Explorer represents each module as an active icon-size block on a map. The process requires you to drag and drop modules onto the map and connect the inputs and outputs. To adjust the controls of a module, you click on the block, and the module launches its own controls window with knobs, dials, buttons, and so on.

The data source does not have to be limited to static arrays. It can be incoming, real-time dynamic data. Explorer comes with tools for describing and reading the incoming data stream and for building your own modules. The modules that come with Explorer are sufficient for many applications, so you can get started looking at your data as soon as you have the software installed. It's clear that no one knows how to take advantage of Silicon Graphics' hardware as well as its own software engineers.

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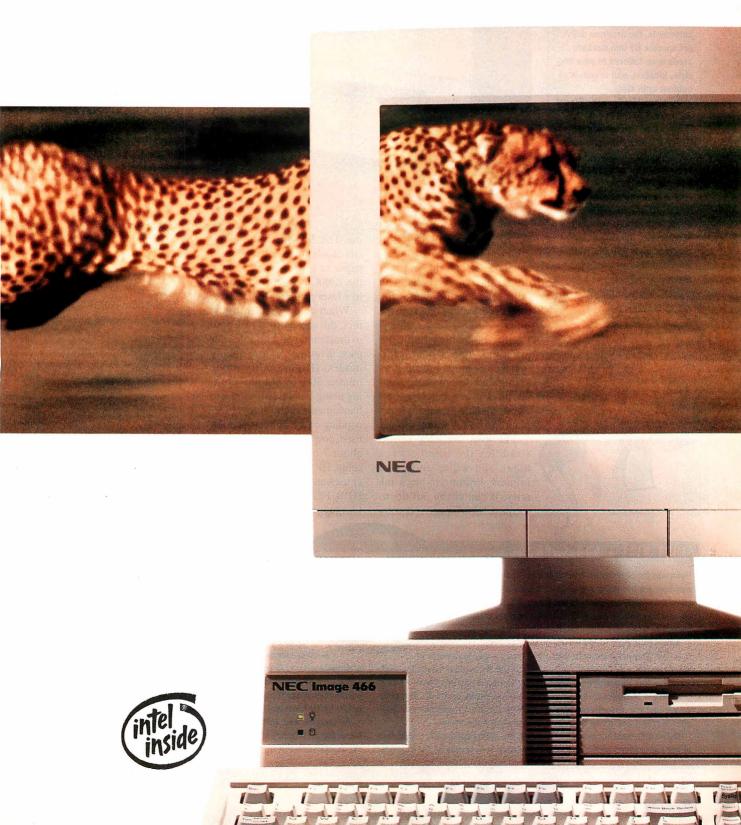
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News & Views

MADE IN THE SHADE

With the depletion of the ozone shield, suntans are out, and sun protection is in. A new program for PCs called UV B-Ware helps you monitor UV levels and peak sunburn times for over 525 locations worldwide. Based on NASA satellite ozone measurements, the program delivers specific UV and sunburn predictions tailored to your lifestyle, location, and schedule of outdoor activities.

Developed by Save the Planet Software ((303) 641-5035), the program can tell you the time the sun is strongest each day for a given location, hours of sunshine for any day of the year, and the percentage of increase or decrease of the particularly damaging UV B-type levels for locations relative to 1980 levels. The DOS-based program costs \$39.95. Windows and Mac versions are planned.



PRINTERS

HP Takes Color Mainstream



900

555-\$UPPORT

ewlett-Packard announced in early May in Europe a new color ink-jet printer that the company says will help broaden the exploding market for color printers in the office. The DeskJet 1200C and PostScript-enabled 1200C/PS are aimed not only at traditional color users, such as marketing and design professionals, but also at general business users, who are increasingly demanding color output.

The new DeskJet 1200C straddles the line between black-and-white and color printers. Printing in black ink only, it can churn out documents at up to 7 pages per min-

ute. The 300-dpi print quality and capability to output to plain paper or transparencies make the 1200C a viable alternative to a laser printer.

When color is added to the mix, the speed drops to 1 ppm in draft mode or 2 minutes per page in normal or high-quality modes. (High-quality mode mimics 300- by 600-dpi printing using HP's Resolution Enhancement Technology.) Depending on the amount of color used, cost per page ranges from about 7 cents up to about 49 cents, HP estimates. The printer uses an enhanced version of HP's PCL (Printer Control Language) 5 with color sup-

port and supports Adobe's PostScript Level 2.

North American pricing is yet to be announced, but the printer will sell in the U.K. for £1389 (non-Postscript) and £1939 (Postscript). That translates to roughly \$2040 and \$2865, respectively, although HP said that U.S. prices can be expected to be lower than those estimates.

-Andy Reinhardt

Hewlett-Packard Co., Direct Marketing Organization, P.O. Box 58059, MS511L-SJ, Santa Clara, CA 95051, (800) 752-0900, (208) 323-2551.

Nonimpact Color Printer Market



According to Hewlett-Packard and industry analysts, the market for nonimpact color printers increased 235 percent from 1991 to 1992. The overall color printer market jumped 109 percent.

JUST DIAL 1-900-SUPPORT

Notorious for provocative late-night advertisements, 900 numbers are becoming a vehicle for technical support at companies such as Apple, Aldus, Lotus, Microsoft, Novell, and Sun. Businessland, CompUSA, and other retailers, as well as VARs, are also exploring 900 numbers.

Although many companies are concerned about customer reaction, they are looking to 900 numbers as a way to make technical support pay for itself, according to Bill Rose, director of the Software Support Professionals Association. To encourage this trend, AT&T is reserving a business-to-business 900-services prefix that will allow companies that are currently blocking out all 900 numbers to unblock these business services and make them available to their employees.

Vari-A-Bill, another new AT&T service, lets technical-support operators either cut or increase the cost of a call while it is in progress. For example,

if a caller identifies an undocumented bug, he or she could be rewarded with a lower rate. Conversely, a caller who has questions that move to the next level of support would pay more.

Some third-party companies also see dollar signs. 900
Support (Lake Oswego, OR) provides 24-hour-a-day Novell
NetWare support at \$4.99 for the first minute and \$2.99 for each

additional minute. CompUSA offers support via 900 lines for hardware and software at \$2 per minute. Some companies, including 900 Support and Corporate Migrations (Dublin, Ireland), have moved into the international market, offering technical support in different languages for U.S. companies.

As systems and software prices continue to fall, technical support is becoming an industry of its own. One way or another, users will end up paying for it.

—Mike Franks



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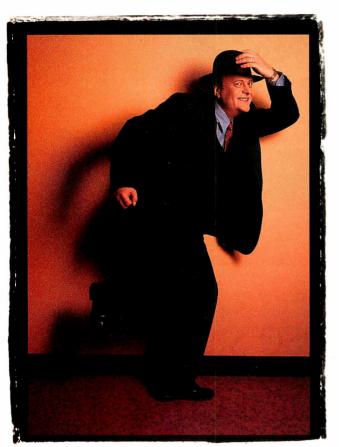
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third and test in a fourth. With OS/2 Crash Protection,™ if one application goes down due to a bug, the rest you're working on won't. "There's no limit to what you can do with this system.... It's definitely made me more productive."

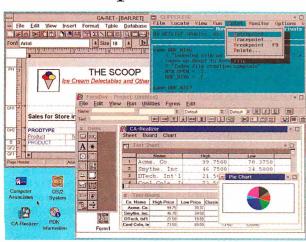
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WORD PROCESSING

WordPerfect Goes GUI with DOS Update

reathing some muchneeded life into its flagship DOS word processor, Word-Perfect recently unveiled a radically updated, GUI-like version of the WordPerfect program. The new WordPerfect 6.0 for DOS also includes portions of the company's PlanPerfect spreadsheet.

With its first major DOS word processor update in more than three years, WordPerfect is protecting its long-held lead in the DOS word processing wars.WP 6.0 for DOS substantially revamps the dated interface of WordPerfect 5.1, adding a slick GUI interface



that lets users edit up to nine documents simultaneously on the same screen. Users have the choice of toggling between the more traditional, faster, character-based text mode and the new, but slower, graphical mode that mimics the look of a Windows product.

"It's a DOS person's dream," says Chris Le Tocq, a senior analyst at InfoCorp (Santa Clara, CA). WP 6.0's capability to handle fonts onscreen without Windows and directly manipulate graphi-

cal text is "quite an engineering feat," he adds. "They've essentially written stuff that's in the guts of Windows."

WordPerfect did not stop at just adding a Windows-like interface to version 6.0; it also offers a host of new features, including the bulk of the functionality in WordPerfect's PlanPerfect spreadsheet. The interface has button bars similar to those used in WordPerfect 5.2 for Windows. It also offers mail enabling; full support of FaxBIOS technology, including drivers for Class 1, Class 2, or CAS-compliant (Communications Applications Specification) fax devices; color printing capability; and the use of scalable fonts with support for Type 1, Intellifont, TrueType, and Bitstream fonts.

Also included in WP 6.0 is QuickFinder technology, which lets you quickly index files, directories, or complete hard disks for doing fast searches on keywords. WordPerfect introduced the QuickFinder late last year in its WP 5.2 for Windows update. WP 6.0 for DOS also comes with a new help facility that's called the WordPerfect Coach.

While WP 6.0 will run on a 286 with DOS 3.0 or higher, 450 KB of free conventional memory, and a 7-MB hard drive, WordPerfect recommends a 386, DOS 5.0, 520 KB of free conventional memory, and a 15-MB hard drive.

WordPerfect says it plans to ship WP 6.0 by June for \$495; full upgrade, \$129; competitive upgrade, \$149.

-Patrick Waurzyniak

WordPerfect Corp., 1555 North Technology Way, Orem, UT 84057, (801) 225-5000.

UPDATE

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Microsoft Word for DOS

Keeping step with rival WordPerfect, Microsoft (Redmond, WA) previewed a new version of its DOS-based Microsoft Word at the CeBIT show held in March in Hannover, Germany. Microsoft Word 6.0 for DOS is designed more for its installed base of Word 5.5 users than to compete with DOS market leader WordPerfect, according to Microsoft. "For us to make this into a WordPerfect killer is a little crazy," says Taylor Collyer, Microsoft's product manager for Word MS-DOS.

Version 6.0 adds a number of new features to Word, including drag-and-drop text-editing capability, support for printing TrueType fonts, and a "ribbon" toolbar similar to that of Word for Windows. With its 3-D-style pull-down menus, dialog boxes, and buttons, the Word 6.0 for DOS update looks more like a Windows product than do previous Word versions, Word 6.0 also offers Reference Software's Grammatik 5. Word 6.0 requires DOS 3.0 or higher, 512 KB of RAM, and a 1.5-MB hard drive (5.5 MB for full installation). Retail price: \$450; upgrades are \$99.

—Patrick Waurzyniak

Ami Pro Burns the OS/2 Flame

otus's Ami Pro 3.0 for OS/2 is a full 32-bit version that is designed to match the popular Windows version feature for feature. These features include a customizable most-recent-files list, text linking between Ami Pro documents, and true background printing.

As with its OS/2 versions of 1-2-3 and Freelance Graphics,



Lotus has integrated Ami Pro with OS/2's Workplace Shell. This lets you drag and drop filenames onto the Ami Pro icon to launch the application, onto the printer to print, or onto the shredder for deletion. The

integration, however, doesn't stop there. From an Ami Pro document, dynamic links with both Lotus 1-2-3 and Freelance Graphics for OS/2 will preserve dynamic links with spreadsheets and charts. And when Lotus Notes and cc:Mail for OS/2 ship, you can expect integration with Ami Pro.

SmartIcons speed a number of tasks for formatting text as well as objects you may want to incorporate (e.g., tables, bit-mapped images, and charts). Another speedup function is style sheets; a third, the macro facility, makes it easy to record and play back a quick step saver or a permanent macro, either of which you can set to execute automatically when you open a document.

-Ed Perratore

Lotus Development Corp., 55 Cambridge Pkwy., Cambridge, MA 02142, (800) 343-5414, (617) 577-8500.



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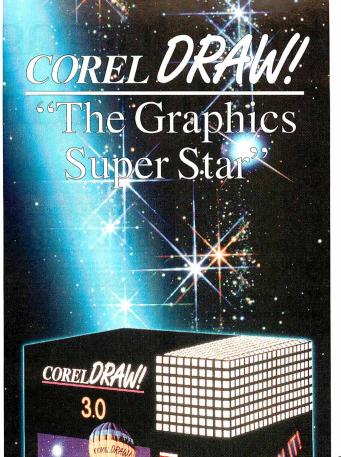
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Our unique MultiDesk desktop manager lets you put related applications, folders and files into their own separate desktops. Set up as many desktops as you like, then switch between them instantly. It all adds up to a less cluttered, more productive Windows environment that works like you do.

File Edit View Layout Font Graphics Window Help BIKES Budgets Font: NewCenturySchlbk (Italic) 6 pt Pa 1 Ln 2.08" Pos 1.73" File Manager PC Tools for Windows Desktop: File Doug's Office <u>Tree View Options</u> Window Help Name New Window bitmap.bmp 67,350 implode Compress excel.xls
gif_file.gif
lotus123 wk3 13,016 Implode docs files 19,836 Stored Expand oldstuff arc 2 460 Implode Dnorypt projects tif_file.tif 154,084 Implode Encrypt winword doc 11,351 Implode Virus Scan All Files Programs Documents Tile Copy File Move File Delete File Print File

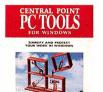
Doug's Office

Desktop: Budgets

[2]

Improve the speed and efficiency of common tasks.

Our integrated File Manager has advanced drag-and-drop capabilities that let you quickly locate, view, copy and print files. With over 75 viewers, you can scan files (including compressed PKZIP data) without having to open their applications first. Hate to turn off your PC because you don't want to set everything up again? Our DeskSaver feature solves that problem too.



Windows® is a great product. And someday, it'll be even better. But why wait?

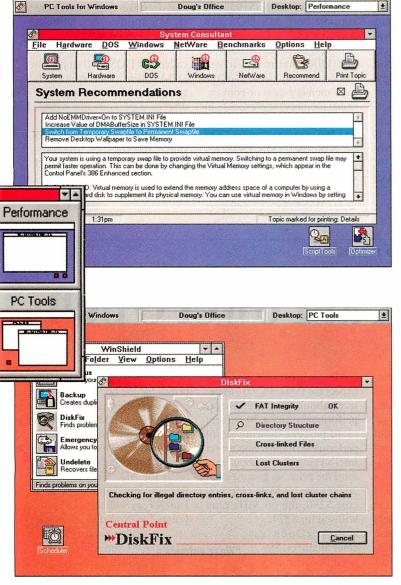
New PC Tools[™] for Windows[®] is here right now. It saves you time, reduces clutter and gives you easy access to all the functions and files

you use most often. In fact, PC Tools for Windows is so innovative that after reviewing it, the editors of PC/Computing asked, "Who needs Macs?"

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ols[™] for Windows. as Windows 4.0.*



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name? Our File Manager lets you quickly view files without having to load the program first. Tired of cryptic, abbreviated file names? Now you can attach long file names to your data to keep things clear and simple.

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EVOLUTION OF THE MOUSE



Mice have come a long way since the original wood mouse (pictured) that was developed by Doug Engelbart at Stanford Research Institute in 1963. Microsoft's first-generation mouse, introduced in June 1983, was based on a prototype made out of clay; the third-generation "Dove bar" mouse was introduced in 1987. Microsoft's newest mouse, developed with the help of an independent ergonomics consulting firm, is designed for either right- or left-handed use. A snap-to feature in the new mouse's software automatically snaps the cursor to the default-command button in a dialog box; screen wrap moves the cursor to the opposite side of the computer's screen when you move the cursor off the edge.

UPGRADES

Novell's "Next-Generation" DOS

y the time you read this, Novell should be beta-testing Novell DOS 7, a major upgrade to the company's operating system that will support true preemptive multitasking, integrated NetWare client support, and peer-to-peer networking. Another new technology in Novell DOS 7 is called the DPMS (DOS Protected Mode Services) API, which Novell says will reduce the demand for conventional, upper, and expanded memory.

The DPMS SDK (\$195) will support both MS-DOS and Novell DOS. It lets software developers write device drivers and TSRs that reside in extended memory (instead of the high-memory area or conventional memory) and execute in protected mode on 286, 386, and 486 computers under DOS or Windows (MS-DOS requires developers to write a separate virtual device driver to execute in protected mode under Windows). Developers

can license and distribute DPMS applications without having to pay royalties.

Novell DOS (formerly called DR DOS) will ship with DPMS client components such as disk cache and compression drivers, a peer-to-peer server, and CD-ROM extensions.

Novell DOS 7 is expected to ship in late summer. The company says it has an installed user base of 8 million for Novell DOS.

-David Andrews

NEW PLATFORMS

A Peek at PowerOpen

hen the first computers based on the new Power-PC chips debut early next year, they'll be able to run character-based Unix and graphical Motif applications concurrently with existing Macintosh programs. Multiple Mac sessions can run side by side in their own Motif windows, and the system Clipboard will let users cut and paste between the Mac and Unix environments. MS-DOS and Windows 3.x programs will run atop an optional software emulator from Insignia Solutions.

Details of the PowerPC's PowerOpen operating system were revealed at the March Uniforum show in San Francisco. Seven companies—led by the original partners, IBM, Apple, and Motorola—formed the PowerOpen Association to promote the new RISC-based platform. Other founding members are Groupe Bull, Harris, Tadpole Technology, and Thomson-CSF.

Motorola officials say they expect the PowerPC 601 to deliver about the same integer performance and a 30 percent to 40 percent floating-point performance improvement over Intel's Pentium—at about one-third the price. In quantities of 20,000, the 50-MHz chip will cost \$280; the 66-MHz chip will sell for \$374.

PowerOpen's chief architect, Stephen P. Cummings of IBM, says hardware and software development are both on track. Tom Whiteside, manager of VLSI technology at IBM's Advanced Workstation Division, says the PowerPC 603 chip currently under development "is intended to be roughly the performance of the 601, but really, really cheap."

He did not disclose specific prices for the 603.

PowerOpen is built on AIX/6000 (IBM's Unix for RS/6000 workstations) and the X Window System. It natively runs Unix applications compiled for AIX, Groupe Bull's BOS/X, and Thomson-CSF's Uni/XT, as well as future programs for PowerOpen. It will

"We're entering a

new frontier...we

intend to price

the PowerPC

aggressively."

—Tom Whiteside

(IBM)

also support COSE (Common Open Software Environment), the "unified Unix."

Apple has ported the Mac OS Toolbox to the Power-PC, so that Toolbox calls execute natively. Because Mac programs typically spend most of their time in the Toolbox, this minimizes the usual performance

penalty for software

emulation.

—Tom R. Halfhill



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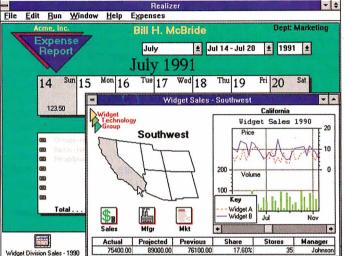
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Arrays are re-dimensioned and processed automatically. Algorithms can be written as formulae instead of complex looped expressions.

Once an application is complete, you can compile it into a stand-alone Windows application and distribute it



royalty-free with the runtime module that's included. And you can generate an installation disk with the push of a button.

PC Computing said, "No other Windows BASIC can match it for power and breadth of features."







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Full Range Of Fast Array Operators & Functions	~	
Mathematical, Statistical, Date-Time Functions	~	Telephone in
Dynamic Addition & Removal Of Form Objects	V	IN THE ALE
Fully-Integrated Programmable Application Tools:	~	T TO MANY
Charts, Spreadsheets, Text Editors, Graphics, Animation, Scheduler	~	
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COMMUNICATIONS

Digicom's Software-Upgradable Modem

he benefit of soft-modem technology is that when you want to extend your modem's communications capabilities, you upgrade your software instead of installing new hardware. A new modem package from Digicom Systems called Connection 96+ (\$199) embodies the benefits of soft-modem technology. Connection 96+ consists of software and a daughtercard that fits into an ISA slot of a PC.

Digicom's soft-modem technology and card combine to deliver 1200- to 9600-bps transmission, v.42 and MNP 4 error correction, a 16550 UART (universal asynchronous receiver/transmitter), and extended AT command-set compatibility. When you purchase the Connection 96+, you are eligible for a free upgrade to 14,400-bps (V.32bis) transmission via Digicom's menu-driven BBS. After I installed the

modem and its software, I downloaded the free V.32bis up-

grade. I used my new—and now improved—Connection 96+ to talk to a 14,400-bps modem I had at home. When I sent the same 68,992-byte file (which I had downloaded from Digicom's BBS) at 14,400 bps, the improvement in transmission speed was obvious. Data blocks zipped by at almost twice the speed as when I downloaded the file at 9600 bps.

Digicom also sells a 9600-bps send/receive fax upgrade (\$60). By the third quarter of this year, the company expects to release upgrades for V.32terbo (i.e., 19,200-/16,800-bps standard) and voice-messaging software. By the end of the year, Digicom ((408) 262-1277) plans to release a Mac model.

-Selinda Chiquoine



LONDON

WHEN YOU CAN'T WAIT FOR FAST, GO TERBO

Tired of waiting for the CCITT to complete its deliberations for the next international analog modem standard known as V.Fast, a group of 18 suppliers that includes AT&T Paradyne, Penril Datacomm, and National Semiconductor has introduced an interim modem standard called V.32terbo. The move followed frustration by vendors that the CCITT rejected a proposal to introduce an enhanced version of the existing V.32bis (i.e., 14,400-bps maximum) standard that would have been called V.32ter and offered a maximum transmission rate of 19,200 bps without data compression. The CCITT thought the proposed V.32ter enhancement represented too small of an improvement compared to V.Fast. The proposed V.Fast standard will offer top transmission of 28,800 bps but is not expected to be ratified for several months.

A U.K. start-up company called Sonix (Cirencester, +44 285 641651) claims to have shipped the first V.32terbo-compliant modem. Sonix's Volante modem (795 pounds) lets users upgrade the modem to V.32terbo from a PC disk. Multitech (Mounds View, MN, (612) 785-3500) says it plans to release a V.32terbo modem this summer. The Multimodem II will cost \$1199.

—Tony Dennis

Visual Basic 3.0 Strengthens Connectivity

ore than 70 percent of all copies of Visual Basic are sold to corporations for developing in-house applications, and more than 90 percent of those custom programs interact with structured databases, according to Microsoft. So it's no surprise that the latest version of VB adds new tools for database connectivity.

Both Standard (\$199) and Professional (\$495) editions of VB 3.0 now have the same database engine found in Access 1.1, Microsoft's RDBMS (relational database management system) for Windows. Thus, VB 3.0 can interact with databases stored in several common formats: Access, dBase, FoxPro, Paradox, and Btrieve.

A new visual data control in the toolbox lets VB programmers hook into these databases without writing any

of the code normally required. In addition, the textbox, checkbox, picture, label, and image controls have been made data-aware. A VB application can now easily access a personnel file that includes

portraits of employees.

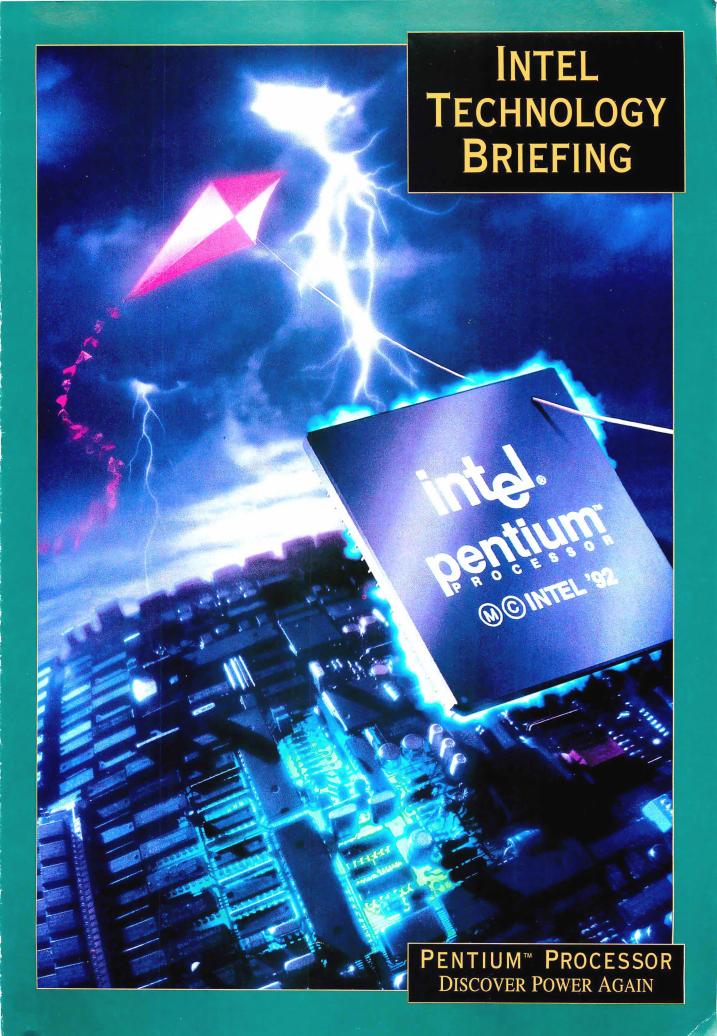
The Professional edition of VB 3.0 adds a programmatic object layer that provides complete control over the Access engine. While the Standard edition lets VB programs interact with existing databases, the Professional edition lets programmers write code that creates and manages databases in any of the supported formats. The Professional edition also has ODBC (Open Database Connectivity) drivers for SQL Server and Oracle.

VB 3.0 supports OLE 2.0 automation, so VB programs can communicate with and control other Windows applications that also support OLE 2.0.

—Tom R. Halfhill

Microsoft Corp., 1 Microsoft Way, Redmond, WA 98502, (206) 882-8080.





How we're giving PCs electrifying Power.



There is a new source of computing power. It's capable of executing two instructions at once. It's produced

processing speeds over 100 MIPS. It's the next generation of compatible power. It's called the Pentium™ processor. And this brief will tell you how its technology is making PCs run faster.

THREE WAYS TO MAKE FASTER PCs.

Faster PCs start with faster microprocessors. And there are three ways to make faster processors:

1. Increase the number of transistors.

Today, the use of sub-micron components lets designers fit more than 3 million transistors on a single chip. So we can integrate components such as math coprocessors and caches right onto the CPU—dramatically cutting access time.

2. Increase the clock speed. Twelve years ago the clock speed ticked

along at a measly 4.7 MHz. Today we can run at an astonishing 66 MHz—and we're still pushing for more.

3. Increase the number of executions per clock cycle.

Using new superscalar technology, our processors are now capable of executing two instructions per clock cycle.

WORKS IN PRINCIPLE AND IN PRACTICE.

Employing the techniques above, we've created the new Pentium processor. A processor that is over 300 times faster than the first PC microprocessor.

THE PENTIUM PROCESSOR. A MODEL OF EFFICIENCY.

The Pentium processor can be described as

a super-efficient factory. Its main assembly line is its superscalar technology—which enables information to be processed simul-

taneously through dual pipelines. To accomplish this, the pipelines divide up an instruction, then send it through five stages. As it passes from one stage to the next, the pipeline is free to begin another instruction. Speeding up operations substantially.

PUMPING DATA THROUGH.

The rest of the features on the processor are designed to keep that main assembly line working at peak capacity (see diagrams). These features, along with the superscalar technology, help the Pentium processor to crunch more than 100 MIPS at a clock speed of 60 MHz.

HOW FAST DID YOU SAY?

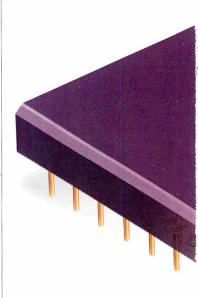
Twice the performance of our own Intel486™ DX2 66 MHz processor. Plus, the redesigned floating-point unit on the Pentium processor offers up to five times the performance of the Intel486 DX2-66 CPU for math-intensive applications.



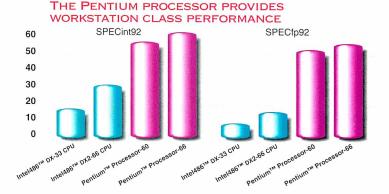




THE NEW PENTIUM PROCESSOR IS FULLY SOFTWARE COMPATIBLE WITH OUR X86 FAMILY.



BASED ON SPEC 92, THE INDUSTRY STANDARD WORK-STATION BENCHMARK, THE PENTIUM PROCESSOR IS IN THE SAME PERFORMANCE CLASS AS THE BEST WORKSTATION. BUT THE PENTIUM PROCESSOR IS RUNNING AT ONLY HALF THE CLOCK FREQUENCY, AND SYSTEMS BASED ON THE PENTIUM PROCESSOR COST ONLY ONE-HALF AS MUCH.





50



200

300 *The iCOMP index is an Intel microprocessor "horsepower" rating. It is a composite of selected performance measurements from SPEC 92, ZD Bench, and Power Meter. Source: iCOMP™: A Simplified Measure of Relative Intel Microprocessor Performance, Intel Corp., 1992

350

400

450

250

WHAT DOES THIS TECHNOLOGY REALLY MEAN?

It means Pentium processor-based PCs are now as fast as workstations. It means faster Intel486 microprocessors, because our experience with Pentium processor technology allows us to improve them. It means new software horizons being brought to more and more users— such as

3-D design, multimedia, handwriting and voice recognition, virtual reality and more.

100

150

WHAT DO YOU NEED?

As you are reading, we are ramping up Pentium processor production. The question is, when will you need a system

> BESIDES RUNNING EVERYDAY APPLICA-TIONS BETTER, THE PENTIUM PROCESSOR PROVIDES THE POWER NECESSARY FOR NEW MULTIMEDIA APPLICA-TIONS LIKE DESKTOP VIDEO CONFERENCING.

based on one? If you're running power-hungry applications, the sooner the better. But for all but the most demanding users, the answer is still an Intel486 CPU-based system. Especially since many Intel486 DX2 processor systems can be upgraded to the same technology found in the Pentium processor with a future Intel OverDrive[™] processor.

TECHNOLOGY YOU TRUST.

550

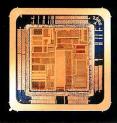
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THE LINE WIDTH OF EACH TRANSISTOR IS 1/100TH THE THICKNESS OF A HUMAN HAIR. OR 0.8 MICRONS TO BE EXACT. SO WE CAN PACK 3.1 MILLION TRANSISTORS INTO AN AREA THIS SIZE.

A PHOTOGRAPHIC MEMORY RIGHT ON BOARD.

NOW THERE ARE SEPARATE 8K CODE AND DATA WRITE-BACK CACHES THAT REDUCE CACHE CONFLICTS AND INCREASE SYSTEM PERFORMANCE. WITH AN ON-CHIP CACHE. WE KEEP ESSENTIAL INFORMATION WITHIN AN ARM'S REACH OF THE MAIN ASSEMBLY LINE. SO THAT INSTRUCTIONS AND DATA CAN BE FETCHED WITHOUT WASTING ANY TIME. AND A FULL 95% OF THE TIME, THE INFORMATION IS RIGHT AT HAND.

THINK OF IT AS A 64-LANE FREEWAY INSIDE YOUR CPU.

TO GET DATA REALLY MOVING, WE DOUBLED THE SIZE OF THE BUS ON THE FIRST PENTIUM PROCES-SOR. THIS ALLOWS TWICE AS MUCH INFORMATION TO BE FETCHED AT ONCE. THERE IS EVEN A BURST MODE FOR HIGH-SPEED INFORMATION TRANSFER-SO MORE INFORMATION GETS TO WHERE IT'S GOING QUICKER. PLUS, AUTOMATIC DATA INTEGRITY CHECKING TO BE SURE THE RIGHT DATA IS BEING MOVED.

WE PROGRAMMED THE CHIP TO BE CLAIRVOYANT.

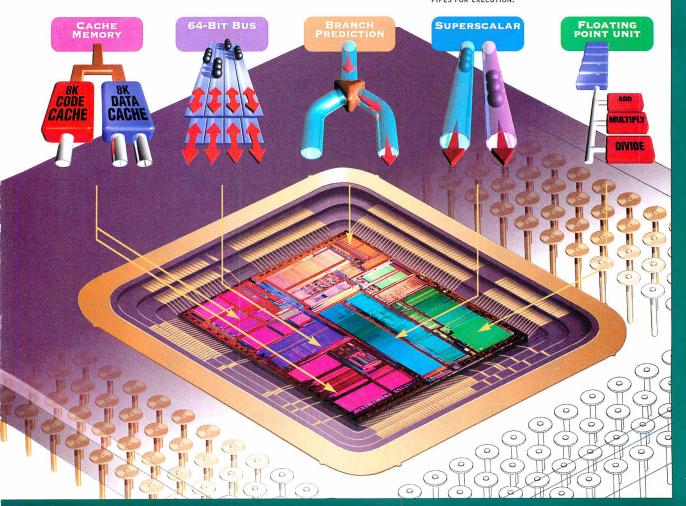
WE'VE GIVEN THE
PENTIUM PROCESSOR AN
INTELLIGENCE OF ITS
OWN—A SMALL CACHE
KNOWN AS THE BRANCH
TARGET BUFFER, WHICH
PREDICTS WHICH WAY
AN EXECUTION WILL
BRANCH. WHEN THE PREDICTION IS CORRECT
(AND IT IS OVER 90% OF
THE TIME), THE BRANCH
IS EXECUTED WITHOUT
DELAY—ENHANCING
PERFORMANCE.

WHO SAID YOU CAN'T DO TWO THINGS AT ONCE?

THE FIRST PENTIUM PROCESSOR HAS TWO SIDE-BY-SIDE PIPELINES FOR INTEGER INSTRUCTIONS. THIS ENABLES THE PROCESSOR TO EXECUTE TWO INSTRUCTIONS AT ONCE. AFTER GRABBING AND PARTIALLY DECODING AN INSTRUCTION, THE PENTIUM PROCESSOR DETERMINES IF THE INSTRUCTION CAN BE EXE-CUTED IN PARALLEL WITH THE NEXT INSTRUCTION IN LINE. IF IT DOESN'T DETECT ANY DEPENDENCIES. THE TWO INSTRUCTIONS ARE SENT ALONG THE PARALLEL PIPES FOR EXECUTION.

A BIG POINT OF DIFFERENCE IN MATH-INTENSIVE FUNCTIONS.

WE'VE ADDED SPECIAL-IZED PIECES OF HARD-WARE TO SPEED UP THE THREE MOST COMMON FLOATING-POINT INSTRUC-TIONS-A MULTIPLIER, A DIVIDER AND AN ADDER. WITH THESE FEATURES, MOST FLOATING-POINT INSTRUCTIONS CAN BE EXECUTED IN A SINGLE CLOCK CYCLE. GIVING YOU UP TO FIVE TIMES THE FLOATING-POINT PERFORMANCE OF INTEL486 DX2-66 CPU-BASED COMPUTERS.



Report from Mexico

D. BARKER

Software Lacks Local Flavor

Arturo Salcido Maese is a software developer looking for his big break. He studied computer science at the Instituto Tecnologico de Estudios Superiores de Monterrey and says had he been born in the U.S., he might have been another Bill Gates. He has written programs he sells, including a set of "Quick" utilities-Quick-Calc, QuickInfo, and others written in Turbo Pascal and priced at less than \$100. "I make software that is easy to use and doesn't cost much money," he says. He meets potential customers face-to-face: he doesn't have a marketing consultant or the luxury of PR. He wants to see homegrown software sold in Mexico.

But the software that gets sold and used here is mostly from the U.S.: Lotus 1-2-3, Excel, dBase, Word, and Word-Perfect. At the recent Expo Comm Mexico computer-andtelecommunications show in Mexico City, the only native software company with a booth was Diagnosticos Admvo Computaror, a developer of business programs, such as Pacioli 2000. The company is famous as one homegrown venture that's prospered beyond the borders of Mexico. Its U.S. affiliate is DacEasy, a Dallasbased company known for its series of accounting programs.

The lack of local software doesn't mean there's a lack of local talent. Mexican universities have long had programs in computer science, and hackers have roamed here since the

dawn of the Apple II. IBM recently moved a programming project from the U.S. to its plant in Guadalajara. But local developers have yet to place a hit on the best-seller list. They're competing with the likes of Microsoft. And, according to some observers, they are also dealing with a native suspicion of things Mexican.

When the Apple II made its debut here, interest was high. "People thought computers were magic," Arturo says. "We thought they would solve all our problems." But there was little software to go with it. Some people became disillusioned. Others realized that the magic of computers requires a certain sorcery on the part of mortals. These people, like Arturo, became programmers.

In some ways, the Mexican computer market is similar to what you find in other industrial countries: The big computer users are large corporations, banks, and government, and they have been replacing their mainframes and minicomputers with microcomputers and PC-based networks.

With an estimated population of 90 million, Mexico is potentially a gigantic market. But outside the urban areas, there are few signs of the computer revolution.

Even in the cities, there is virtually no home computer market. Systems are just too expensive. Those prices are coming down, however. Gama Computadores, which manufactures PCs in Mexico, now sells 386SXes for around \$800.

"A year ago, prices were

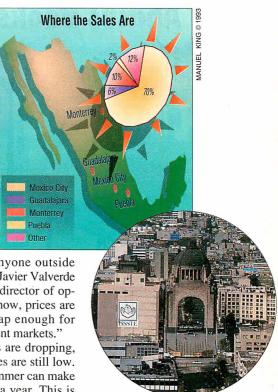
too high for anyone outside business," says Javier Valverde Polin, Gama's director of operations. "But now, prices are becoming cheap enough for home and student markets."

While prices are dropping, Mexican salaries are still low. A good programmer can make about \$18,000 a year. This is certainly much more than most Mexicans make, but it's by no means the comfortable living of a programmer wrangling code north of the Rio Grande.

One problem with U.S. software coming into Mexico is the documentation. Either it's in English or it's translated in Spain, into Spanish Spanish rather than Mexican Spanish. There are anecdotes about neophytes reading the instruction "Insert DOS disk," translating DOS into its Spanish equivalent, and then trying to insert two disks into the PC. Terms like "Boot the computer" don't translate well, and the Mexican word for turning on an electronic device—encienda, to put fire into-would seem odd to a Spaniard.

When we met here in February, Arturo was hoping to soon find a partner who could handle the business side of marketing his software, who could get it on the shelves of computer stores. When we spoke again recently, he was still looking.

D. Barker is BYTE's managing editor. He can be reached on BIX as "dbarker."

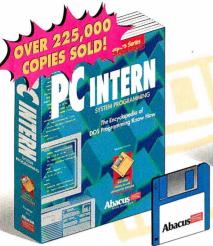


Three cities account for most of Mexico's computer market: Mexico City, Monterrey, and **Guadalajara. These cities** buy 85 percent of the computer products sold in Mexico. With 20 million people, projected to reach 27 million by the year 2000, Mexico City is a big market unto itself. One resident told a visitor, "Maybe computers can solve our traffic problems." (Market information from

(Market information from Servicios de Estrategia en Electronica.)

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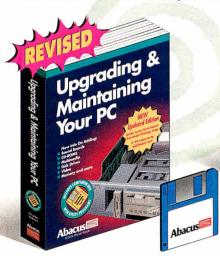
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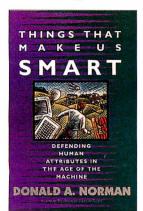
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Reviews Books & CD-ROMs

Computer Ruminations



BEFORE THE COMPUTER by James W. Cortada THINGS THAT MAKE US SMART by Donald A. Norman

ime was, when a rifle part wore out, the gunsmith fabricated a new one. The technology to mass-produce replacements that didn't need custom fitting was one by-product of the Civil War; that was the technology that, after 1865, made possible typewriters and cash registers and accounting machines. (No, it's no accident that "Remington" denotes both an office appliance and a gun.) James W. Cortada's intricate history of such artifacts is called Before the Computer, and, indeed, it's the computer that has

now pretty well subsumed them all. In their day they filled immediate needs, and no one dreamed that a century down the road lay a single supermachine.

Donald A. Norman's Things That Make Us Smart is a complementary account. Although Norman is an Apple Fellow ("the highest-level technical appointment at Apple"), his new book's attention to computers is intermittent at best. Still, they're never far below the horizon of his ruminations, subtitled "Defending Human Attributes in the Age of the Machine." (No, not that tired old tune, dehumanization; Norman's attention is on technology that gets in the way in its eagerness to be helpful.)

Take five pieces of software: dictionary, encyclopedia, thesaurus, spelling checker, and language translator. "Their function would be greatly enhanced if they could all be combined into one." As it is, they can't even intercommunicate, unless thanks to a complicated shell like Windows. Unimaginative programmers? A "tangled web of financial and copyright arrangements"? Norman guesses it's probably both.

Or consider the filing drawer. It was "a major revolution in handling information" when it was first introduced early in this century. It depended on carbonlater, xerographic—copies, and on standardized paper sizes; then, "courses on methods for filing" could become a booming industry. Before the filing drawer, there were desks with pigeonholes. (The holes and slots and drawers were of varying sizes because documents were. "Pending bills" might consist of many small envelopes, "bank records" of several large checkbooks.) And with 60 to 100 places where some item might have been stashed, a human memory with a span of only five to seven categories was a crippled access device indeed.

You can see with what caution all these metaphors need to be looked at as we "computerize." Early in the book, Norman offers an arresting analogy. Here's a game called 15. Its pieces are the nine counting digits. Each player in turn takes possession of a digit. The winner is the first player to get three digits that sum to 15. Try it. You'll discover that, "Though the arithmetic is simple, keeping track of all the possibilities...makes the game difficult."

And here's tic-tac-toe, at which any kiddie speedily becomes expert. And

here's the killer: The two games are identical. What a difference the representation makes! And finally: A computer program written to solve tic-tac-toe spatially, the way we do, "would have to figure out whether the X's and O's were on a straight line," a problem in trigonometry. For fast computerization, convert the game to 15. ■

BEFORE THE COMPUTER James W. Cortada, **Princeton University Press,** ISBN 0-691-04807-X

THINGS THAT MAKE US SMART Donald A. Norman. Addison-Wesley,

ISBN 0-201-58129-9

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his seems just what the thesis director ordered, a computerization of such a library assignment as used to send graduate students flocking to the stacks in tight patterns. The idea was to get there before too many others got there, else every book would be checked out. But now, forget books! What we have here is a big database of American history texts, plus a fast search facility that handles AND, OR, and NOT-even things like "All paragraphs containing both freedom and liberty or both peace and prosperity."

The search works fine. The problem is what we're searching through. Here's a category called First-Hand Sources, amid which we pick the subhead Revolution, and then the document called The Defeat of Burgoyne at Saratoga. Bring up this document and find the following heading: "TITLE: The Defeat of Burgoyne at Saratoga/AUTHOR: Sir Edward Creasy/DATE: 1777/SOURCE: Great Epochs in American History, Vol. 3, Pg. 155-164." You'd expect DATE to be the date of the document, but no, it's the date of the event under

And the Creasy pages are from Sir Edward Shepherd Creasy's Fifteen Decisive Battles of the World, a classic published in 1852. Great Epochs? That's a 1992 catchall, edited by (it says here) Francis W. Halsey and available only via Infobases, which is also our source for the present CD Sourcebook. What it puts on your screen isn't print but facsimile typescript. As far as I can make out, running standard printed editions through a scanner was harder than just retyping their hundreds of pages in a uniform format (and no guarantees of accuracy). That's typical. And no thesis director would accept so amorphous a reference.

I'm sorry to report that something's been blown again. The idea is good, and the search engine is very good. But the realities under which someone will need this package have not been envisaged at all.

-Hugh Kenner

Hugh Kenner is Franklin and Callaway Professor of English at the University of Georgia. He writes for publications ranging from the New York Times to Art & Antiques. You can contact him on BIX as "hkenner."

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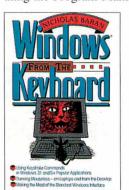
Reviews Books & CD-ROMs

THE KEY INGREDIENT

WINDOWS FROM THE KEYBOARD by Nicholas Baran John Wiley & Sons, ISBN 0-471-59093-2, \$16.95

mouse may be appropriate for a windowed environment, but is it required? Not according to Nicholas Baran. His Windows from the Keyboard is devoted to operating a Microsoft Windows environment totally from the keyboard. Baran, a BYTE consulting editor, doesn't propose that we should forgo the use of mice. Rather, there are times, such as when traveling with a portable, when it is worthwhile to be able to work without having a mouse attached to your system. Likewise, some people. such as touch-typists, want their hands at the keyboard as much as possible.

Windows from the Keyboard starts with an overview of operating the Program Manager, File Manager, and other system-



level programs. It then explores keyboard control over six Windows applications: Ami Pro, Microsoft Word, WordPerfect, Microsoft Excel, Lotus 1-2-3, and Quattro Pro. Baran includes detailed instructions as well as useful summary pages that you can copy and place next to your computer. If you prefer working from the keyboard, this book will help you get the most efficient, flexible use from your Windows applications.

-Raymond GA Côté

UNIX WIZARDS

UNIX POWER TOOLS by Jerry Peek, Tim O'Reilly, and Mike Loukides O'Reilly & Associates and Bantam Electronic Publishing, ISBN 0-553-35402-7, \$59.95

ehind every smoothly running Unix environment is a Unix wizard. You can identify them by their ability to utter mind-boggling keyboard incantations. As with wizards of old, their power comes not from some mystical source, but from hardearned knowledge. Unfortunately for the uninitiated, this knowledge is locked within hundreds of books and thousands of articles.

Unix Power Tools unlocks the storehouses of knowledge and can make a wizard out of anyone willing to spend time getting comfortable with the tools. This 1168-page book is not designed

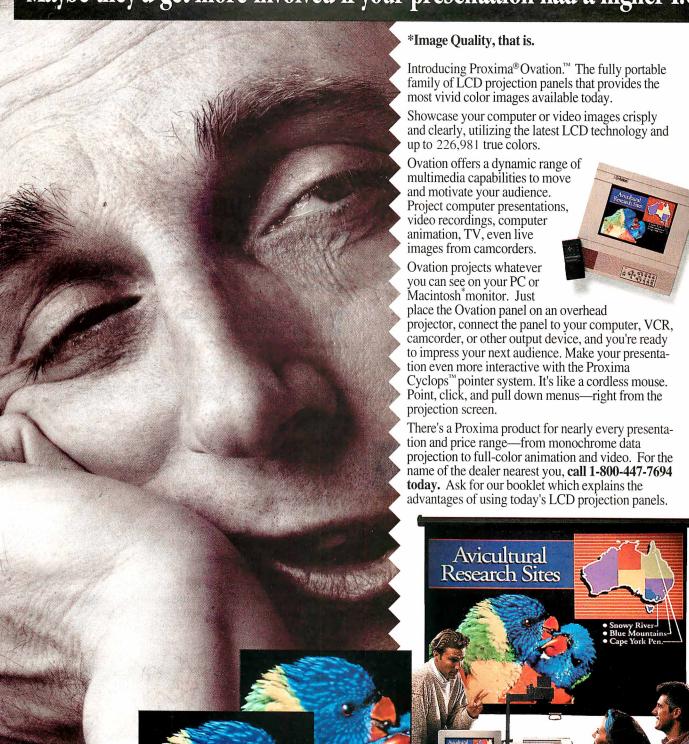


for casual reading. Instead, graze through it for solutions and ideas. It starts with the administrative basics of maintaining user profiles, log-in scripts, passwords, and directory structures. Each chapter consists of terse solutions to specific problems (e.g., setting terminal types, seeing log-in mes-

sages just once a day, and configuring environment variables).

Moving on, you encounter techniques for navigating the file hierarchy, finding files, dealing efficiently with directories having thousands of files, and looking inside the found files. Once you find the files, you manipulate them with tools ranging from

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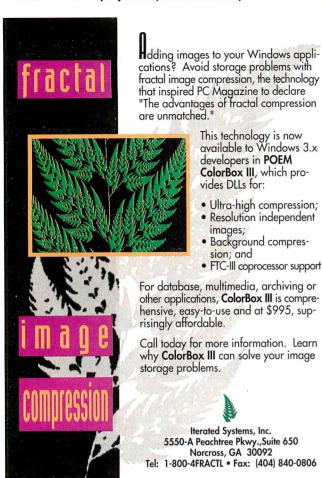
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simple editing with vi to industrial-strength manipulation with emacs, and a slew of automated manipulations, from sed through Perl. Every tool mentioned in the book is available in both source code and executable form on the accompanying CD-ROM.

Unix Power Tools is an encyclopedic work that belongs next to every serious Unix user's terminal. If you're already a Unix wizard, keep this book tucked under your desk for late-night reference when solving those difficult problems.

-Raymond GA Côté

HARDWARE HELPER

NETWORK INTERFACE TECHNICAL GUIDE, \$119.95 ENCYCLOPEDIA OF MAIN BOARDS, \$499.95

Micro House International, 4900 Pearl East Circle, Suite 101, Boulder, CO 80301, (303) 443-3388

he *Network Interface Technical Guide* and *Encyclopedia* of *Main Boards* are meant for technicians, computer magazine editors, or anyone who spends much time chasing down switch settings for obscure boards. The first book is an 800-page volume with switch and jumper settings for 330 network cards. Each entry includes a drawing of the card showing the key components, a table of possible settings, and a collection of applications notes. Just as I started looking at this book, I had to install a Novell NE2000 adapter. I quickly found it in the index, and within minutes I had the card configured and installed.

The four-volume *Encyclopedia of Main Boards* contains board layouts with switch and jumper settings for 980 system boards. I tried to spot-check a half dozen or so boards in PC clones at BYTE, without success. I was disappointed that this encyclopedia didn't show *any* of them, when there are over 3000 different system boards out there. Micro House plans to expand the set to six volumes, covering 400 additional system boards, this summer.

The encyclopedia includes a handy disk database of the system boards in the set. You can search by manufacturer, CPU, processor speed, and other criteria, and the process is much faster than leafing through the table of contents. It also includes a list of common acronyms and a glossary of computer terms. I found a few inaccuracies. The glossary incorrectly shows the 8086 processor as the one in the IBM XT, for example.

Both books could pay for themselves in time saved. Just make sure they cover the boards you have in your systems.

—Howard Eglowstein

THE CD-ROM AUTHORITY

CD-ROMS IN PRINT 1993, Meckler Publishing, ISBN 0891-8198, \$95

eckler's definitive international guide to CD-ROMs is a 736-page book (it's also on CD-ROM). The entries appear alphabetically by title, with indexes on subject, publisher, distributor, and other categories. It's the reference for anyone who needs to quickly track down all titles for a given subject.

-Rob Mitchell

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Editor

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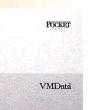
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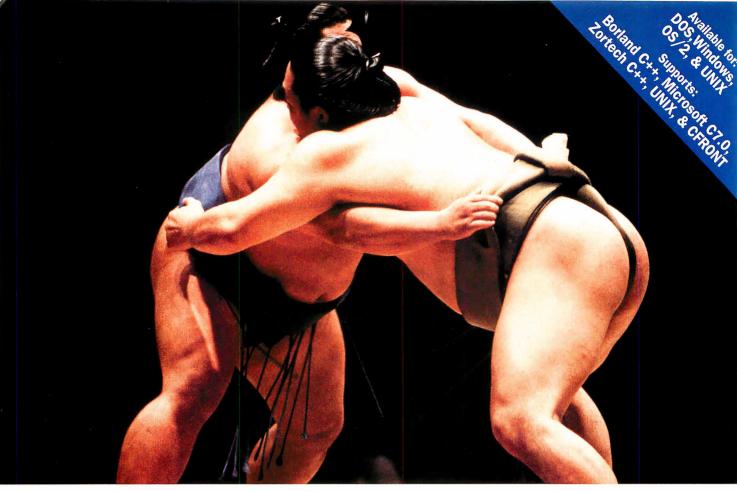
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Benchmarks published in Byte Magazine, January 1992

^{**}Reviewed in the "Toolkits" section of PC Magazine, November 10, 1992

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Computers for the Disabled

JOSEPH J. LAZZARO

al has all the makings of a good telemarketer: He's bright, outgoing, and persistent. He is also blind. Phyllis wants to hire him, but she has some concerns. How will he be able to use the company's database if he can't see the monitor? How will he read office correspondence? And more important, what will it cost the company to adapt the workplace to accommodate him?

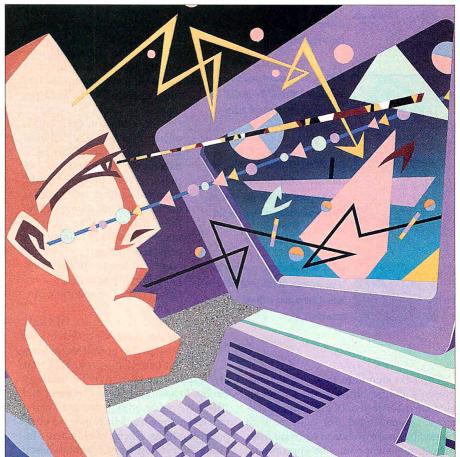
Phyllis must accommodate him, since her company is in the U.S., and therefore subject to the Americans with Disabilities Act, or ADA (see the box "For More Information"). But she needn't worry. The latest adaptive technology for personal computers provides a cost-effective way to allow Sal and workers with other disabilities to do their jobs with independence.

Getting Access

Personal computers are directly compatible with many adaptive hardware and software products. You simply install them as you would any other addin board or application. The majority of adaptive products are developed for the platforms that are commonly used in business environments: MS-DOS, Windows, and the Macintosh. Fewer products are available for Unix, but development work is under way due to the influence of the ADA.

When adapting a personal computer, you should pay special attention to hardware requirements (see the box "Adaptation Needs"). Both PCs and Macs require at least 25 MHz of processing power to run many adaptive applications, such as OCR or speech-synthesis programs, in conjunction with mainstream programs, such as spreadsheets.

Memory is another major consideration. For adaptation, many systems require a minimum of 1 MB of RAM-4 MB if you're running Windows or if you're attached to a network. The number



Adapting desktop computers to meet the needs of disabled workers is easier than you might think

of expansion slots is also vital. For instance, if you have a machine with five slots, you can install a speech synthesizer and an optical scanner alongside your video and drive controllers and still have one slot free.

Another important issue is how many serial and parallel ports your computer has. Many adaptive devices interface to the computer through serial ports, using standard nine- or 25pin connectors.

Analyze, Then Adapt

The first task in adding adaptive technology to a computer is to determine the specific needs of the disabled worker in question. "It's very important to analyze the job thoroughly," says John Robichaud, a rehabilitation engineer with the Occupational Rehabilitation Group (Cambridge, MA), "and this goes way beyond just the PC." Robichaud's company looks at each job in terms of its component tasks and all the systems at the site used to perform those tasks.

Adaptation Needs



HARDWARE: Both PCs and Macs require at least 25 MHz of processing power to run many adaptive applications, such as speech-synthesis programs, in conjunction with mainstream programs, such as spreadsheets.



MEMORY: Many systems require a minimum of 1 MB of RAM—4 MB if you're running Windows or if you're attached to a network.



EXPANSION SLOTS: With five slots, you can install a speech synthesizer and an optical scanner alongside your video and drive controllers and still have one slot free.



ROBERT BURGER © 1993

PORTS: Many adaptive devices interface to the computer through serial ports, using standard nine- or 25-pin connectors.

The next step is to focus on the employee's abilities. If he or she has no vision, then a speech or braille output package is recommended. For someone with limited but usable vision, a software magnification package may be appropriate. For a hearing-impaired worker, a Bau-

dot/ASCII modem is a logical investment. For a motor-disabled user, an adapted keyboard or a Morse-code entry system is feasible

To assist with adaptive technology, mainstream companies are providing consulting services and adaptive equipment to comply with the ADA. The SNAP (Special Needs Access Program) is a joint project of AT&T and NCR. It offers engineering consulting services and adaptive hardware and software for fees ranging from \$75 to \$125 per hour.

Cortez Martin, civil rights manager for the FAA Technical Center at the Atlantic City International Airport, used the SNAP to help accommodate a visually impaired worker. "We gave the consultants a real thumbs-up for their efforts and the approximately 20 hours of training they provided," he says. "The software and hardware they suggested made [our] employee more productive and more efficient."

DEC is using its DECtalk speech-synthesis system to help blind people to read and nonverbal people to speak. DEC has

also created an Assistive Technology Group. In addition, Apple Computer and IBM have produced and sponsored assistive technology for their respective computer platforms. Their developments include everything from graphics-based speech-synthesis systems to sticky-key software (i.e., programs that electronically lock and hold the Shift, Ctrl, and Alt keys).

Adapting to a Specific Need

To work effectively, most vision-impaired users need to have their computers adapted with technologies such as speech synthesis, magnification, braille, and OCR. Speech-synthesis systems interface to a



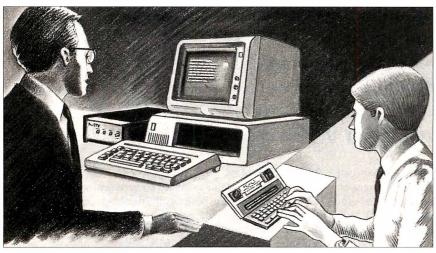
A PC for a blind user, equipped with an Oscar optical scanner and a braille printer, both by TeleSensory. The optical scanner converts text into ASCII code or into proprietary word processing format. Files saved on disk can then be translated into braille and sent to the printer. Visually impaired users can also enlarge the text on the screen by loading a TSR software magnification program.

computer through 8- or 16-bit slots or through standard RS-232 serial ports. They rely on TSR packages, known as screen readers, to drive them.

One example of a speech-synthesis system is VertPro from TeleSensory (Mountain View, CA). This \$1795 product can read MS-DOS-based word processors, databases, spreadsheets, and other text-based software. Window Bridge from Syntha-Voice (Hamilton, Ontario, Canada) is a \$695 Windows-based screen reader. This product can verbalize both MS-DOS- and Windows-based applications, and it will drive most speech synthesizers.

Magnification software can enlarge text appearing on the screen by up to 16 times. ZoomText Plus (\$595) from AI Squared (Burlington Center, VT) and Magic Deluxe (\$295) from MicroSystems Software (Framingham, MA) can both enlarge text on MS-DOS and Windows applications. Berkeley Systems (Berkeley, CA) markets inLarge, a \$195 Mac-based software package that magnifies most commercial applications.

For braille output, the Juliet printer



This deaf user's PC is connected to a telephone via an Ultratec Intele-Modem Baudot/ASCII modem. The user is sending and receiving messages to and from someone at a remote site who is using a telecommunications device for deaf people (right).

Why some software sells more than others.

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Struggling Software Sales

One day, trekking through the coffee fields of Java, Don ran into his old college buddy Simon Seagull. "Don, my sales are well below expectations." Simon explained his plight, "My software should sell like yours, Don!" Yet despite critical acclaim Simon's company, SimonSays Software, teetered on a financial tightrope. "What's your secret, Don?"

They spent hours analyzing potential problems. They looked at everything.

The Key to the Problem

Finally, Don leaned back and asked the assumptive question, "What about protection – are you using Sentinel?" Nervously, Simon sipped his coffee. His hands shaking as his eyes darted the room. "No. I didn't think I needed to."

Don's chair slid out from under him and he crashed to the floor. Amazed in disbelief, Don cried, "You What?!" Grabbing his tattered

scrapbook, Don pulled out photos of his travels. "Ever been to Seoul? Prague? Anywhere? Ten bucks will buy you anything, even bootlegged copies of software."

Don's Road to Success

Thumbing through the scrapbook, Don shared his experiences. "Back in the '80s, I was in your shoes – beaten, battered and bruised."
Simon listened. "Then, after a heart breaking trip around the world, I called the Software Publishers Association (SPA)."

"I could hardly believe it. They told me developers lose billions of dollars each year. Why? Illegally copied software. In some countries there are nine pirated copies for each legal copy sold." Simon was disgusted, "It's just not fair." "That's why I committed

myself to solving the piracy problem," explained Don.
Simon's eyes lit up. "The dongle!" he shouted. Don cted him, "Not just any the dongle that

corrected him, "Not just any dongle — the dongle that paved the road to success for over 10,000 developers worldwide — Sentinel."

Successful Developers Use Sentinel

Don pulled a stack of letters out of his gunny sack. "All of these people tell the same story." Don read about a successful developer from California who swears she wouldn't be in business without Sentinel. Another company says protection costs less than litigation, plus they don't have to spend time and money supporting

illegal users.
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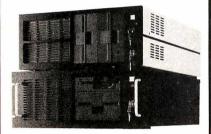






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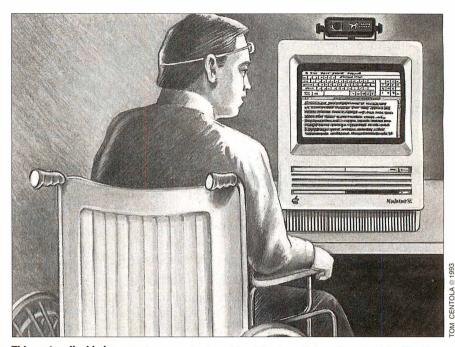
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Feature

(\$3995) from Enabling Technologies (Stuart, FL) interfaces to any standard RS-232 serial or parallel port. Juliet can emboss braille on both sides of a page at a speed of 40 characters per second. The Reading Edge OCR (\$5495) from Xerox Imaging Systems (Peabody, MA) and the Arkenstone Open Book Unbound (\$2190) from Arkenstone (Sunnyvale, CA) can read printed material to blind people and send of the keyboard on the screen. These products use a head-mounted pointing device. Examples include HeadMaster (\$1195) from Prentke Romich (Wooster, OH) and the FreeWheel (\$1395) from Pointer Systems (Burlington, VT).

With these systems, a motor-impaired person can bypass the physical keyboard with an external adaptive switch to select menu choices or virtual keys from an on-



This motor-disabled person is communicating with a PC using a Pointer Systems optical head pointer to access all keyboard functions on a virtual keyboard shown on the PC's display. The user can "strike" a key in one of two ways. He can focus on the desired key for a user-definable time period (which causes the key to be highlighted), or he can click an adapted switch when he

the text to a PC.

chooses the desired key.

For users with hearing impairments, there's a long list of available adaptive hardware and software that you can add onto PCs. For example, SeeBeep (\$20) from MicroSystems Software translates IBM speaker output into visual signals. Computers that are equipped with Baudot/ASCII modems can act as telecommunications devices for deaf people and also communicate with other PCs. Examples of this type of modem are the \$329 Intele-Modem by Ultratec (Madison, WI) and the \$349 CM-4 from Phone-TTY (Hackensack, NJ).

To adapt equipment for motor-impaired workers unable to type on a standard keyboard, you can employ adapted keyboards, sticky-key software, head pointers, and Morse-code systems that bypass the keyboard and enter data through the RS-232 serial port. In tandem with these add-ons, you can install software to display a picture

screen keyboard. Adaptive switches come in a variety of forms that can be activated by eye movements, breath control, or any other reliable muscle movement.

Another way of controlling computers is via a Morse-code system. Such a system consists of adaptive switches and software for people who can't type on a full keyboard but have the ability to physically push at least one key. HandiCode (\$495) from MicroSystems Software is such a program. Voice-recognition systems permit people to issue verbal commands to a computer to perform data entry. Among the available voice systems are two from Dragon Systems (Newton, MA): Dragon-Dictate-30K (\$50) and VoiceType (\$1995 plus board).

What's in the Works?

Adaptive technology must struggle to keep pace with the mainstream computer industry. For instance, numerous DOS-based



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Feature

screen readers exist, but few GUI screen readers are available. The use of multimedia could prevent blind users from accessing the information servers of the future unless a method can be found to translate animation into either speech output or braille. Pen-based computers could prevent the use of adaptive equipment for two reasons: They lack expansion slots for specialized hardware, and the heavily visual operating system isn't friendly to blind users.

Another problem is the long stretches

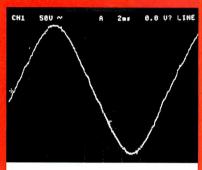
of time between the appearance of mainstream products, such as spreadsheets and word processors, and those products' ability to interact with adaptive equipment. Ideally, this lag time will decrease as companies consider adaptive access early on in the design stage.

On July 26, 1994, companies with as few as 15 employees will be mandated to comply with the ADA. This criterion will make the ADA applicable to many more businesses. Because of the implementation of this new law, and the ever-increas-

For More Information

- By calling the toll-free hot line at The National Institute on Disability Rehabilitation and Research (NIDRR) in Washington, D.C., at (800) 949-4232, you will be directly connected to your nearest ADA technical assistance center.
- You can obtain a free handbook (in either hard-copy or electronic form) about how to add adaptive technology to personal computers from the Clearinghouse on Computer Accommodation (COCA) of the Information Resources Management Service, General Services Administration. Write to: Susan A. Brummel, Director, COCA, c/o GSA, Room 2022, KGDO, 18th and F Sts. NW, Washington, DC 20405.
- State rehabilitation agencies, which are usually located in your state capital and listed in the phone directory, are a source of free information on ways to comply with the ADA.
- DOS-Abledata is a CD-ROM database from the Trace Center in Madison, Wisconsin. You can purchase this CD-ROM directly from the Trace Center for \$25. You can also access its contents via the Massachusetts Commission for the Blind's BBS at (617) 451-5327 or via Project Enable (a disability-oriented BBS) at (304) 766-7842
- The Internet has at least two newsgroups covering disability-related issues. These groups are called misc.handicap and alt.education.disabled. On-line services such as GEnie, BIX, CompuServe, and Delphi also have forums dedicated to adaptive technology.
- The Department of Justice runs a BBS dedicated to providing information on the ADA.
 To access it by modem, call (202) 514-6193

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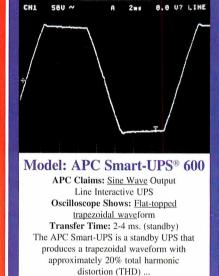


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Tests were performed on a Tektronix Model 2430 digital osciloscope; scale 1 div = 56 volts; vert, 1 div = 2 ms.; horizontal. The ambient test environment was 68—72°F and 15—45% elative humidity. Softi UPSs tested were rated at 800 VA. A 47 ohm load (300 watts nominal) was used. All UPS batteries were brought to a full state of charge before testing. Osciloscop photographs were all taken at the same point in the battery cycle. Dade of test: February 25, 1993. All UPS systems were purchased through commercial sources.

Models used: Unison* 6.0A and Smart-UPS* 600. Smart-UPS* is a trademark of American Power Conversion.

ing pervasion and decreasing costs of PCs, the future of adaptive technology is on a rising curve.

The payoff of the availability of adaptive equipment benefits everyone. "Building access for disabled people is the same as building better interfaces for all users," says Janina Sajka, project manager of the World Institute on Disability Network (Oakland, CA). "By studying the needs of disabled workers, we have the opportunity to build better access for everyone."

Joseph J. Lazzaro is director of the Adaptive Technology Program at the Massachusetts Commission for the Blind in Boston. He is the author of Adaptive Technologies for Learning and Work Environments (American Library Association, forthcoming). You can contact him on BIX as "lazzaro@bix.com" or on the Internet at lazzaro@world.std.com.



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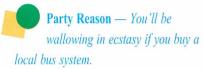
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Aren't you glad you peeked at our gift? Now you know Gateway 2000 offers the best value — today *and* tomorrow.



Party On With Value-Priced Portable

Keep counting the reasons to celebrate during Gateway's 486 Fest! You'll find plenty when you look at our Nomad notebook PCs and computer peripherals!

Nomad Notebooks

Party Reason — You'll get 486 desktop performance in a lightweight portable when you buy a Nomad.

Why settle for a 386 notebook when you can get a powerful 486 Nomad in the same price range? All three Gateway 2000 Nomad models are 486 systems with snappy performance that's still rare in notebooks. Plus, they're smaller than many notebooks, weighing just 5.6 pounds and measuring 8.5" x 11" x 1.8". No other notebook this size can beat the Nomad 450DXL's combination of performance and battery life! In PC Magazine's Battery Rundown Test, Nomad systems operated up to six hours on a single battery with power management enabled.

Party Reason — *No more squinting at a dim and fuzzy display!*

Nomad screens are big and brilliant — a full 10" VGA backlit display with 64 gray scale. You can use your Nomad in all lighting conditions.

Party Reason — Three cheers for a great keyboard and mouse!

Nice feel! The 79-key touch-type keyboard is comfortable, quiet and fast. Nomad 450DXL models now also include Microsoft's® Ballpoint™ portable mouse with Quickport,™ standard.

We have lots of options for our Nomads, too. Call for details!

Peripherals

Party Reason — You'll save money on connectivity tools!

TelePath™ Fax/Modem. It's everything you ever wanted in an internal fax/modem, including a great price! The Gateway 2000 TelePath is a 14,400bps modem, V.32bis, with 9,600bps fax capability. It's compatible with the standard AT command set and is downwardly compatible with

lower modem speeds. Package includes software — WinFax Pro,[®] Crosstalk[™] for Windows and Qmodem — plus a free CompuServe[®] trial membership. \$195

Network Cards. Call for a selection of Ethernet cards and Token Ring adapters, installed and configured.

Microsoft Windows™ for WorkGroups.

Networking made easy! Share files and printers, send electronic mail, schedule group meetings with the click of your mouse — and get everything you need in one inexpensive package. That's the beauty of Windows for Workgroups. Even a beginner can set up and configure a network with this fantastic product. Price includes an Ethernet adapter and software. Hardware and software are factory-installed. \$159

Party Reason — You'll save money on multimedia software and peripherals!

CD-ROM Kit. You'll enter a whole new world of possibilities with your PC when you add a CD-ROM drive, giving you access to exciting new applications, databases and entertainment programs. With applications continually getting bigger, wouldn't it be convenient to get software on a single CD rather than piles of floppy disks?



And Peripherals!

Comparable CD-ROM drives usually retail for over \$400. Manufactured specially for Gateway 2000, this kit includes CD-ROM, interface card and everything you need to add MPC-compliant CD-ROM to your PC. \$225

Microsoft Windows Sound System.™

Here's the sound system designed for business, complete with a headset for private office use. You can "speak" commands to your PC for hands-free operation. Let your PC read numbers back to you for proofing spreadsheets. Embed audio messages in Windows OLE applications. Add audio to screen savers. Play your Ad Lib® and Sound Blaster™ games — and more! Our special Gateway price includes soundboard, microphone, headset and software. \$149

Party Reason — You'll save money on all kinds of extras from Gateway!

Colorado Memory Systems™ TBU.

250MB internal automatic tape backup unit copies up to 9.5MB per minute with high-speed data compression. Reads previously formatted Archive™ tapes, too. Comes with easy-to-use DOS software, one tape and cable. 486 Fest price: \$195!

CrystalScan[™] 15-Inch Monitor.

Non-interlaced color monitor with flat, square screen. If the system you want is advertised with a 14-inch monitor, you can upgrade at the time of purchase to a 15-inch monitor for only \$100.

Panasonic® KXP2123 Color-Capable

Printer. Add color to your documents with this 24-pin dot matrix printer. Includes Adobe Type Manager.[®]
Call for 486 Fest price!

Texas Instruments® MicroLaser™ Plus

Laser Printer. Never before has such a small, Postscript® laser printer offered so much speed and economy. The MicroLaser Plus is only 13.4" x 14.2", yet it prints 9 pages per minute at 300dpi. Call for 486 Fest price!



We offer many other system options and upgrades, including 17" and 20" monitors, tape backup units, bigger hard drives, other software and more! Call today!

The software and peripherals listed here are sold only with the purchase of a system. For details on our complete line of extras for Gateway customers, ask for our special add-on components division when you call.





Celebrate! We Give You More Softward

That's right! We have even more reasons to party during Gateway's 486 Fest! We offer more free choices of application software with our systems than any other manufacturer. Plus, all software is preinstalled and ready to run the moment your system arrives. Hooray! No installation hassles!

With Nomad, mini desktop and our 4DX2-66 Best Buy systems, you get Works, one of the best integrated software packages on the market.

Party Reason — Microsoft Works for Windows.TM

Works for Windows is the single program that combines all the tools you need to run a business: word processor, spreadsheet, database and electronic communications. It's simple to use yet provides power and functionality for advanced users.

With desktop and tower systems that include "choice of application software," you can select one of the following software packages. All applications are the latest versions.

Party Reason — Microsoft Excel for Windows.™

Microsoft Excel gives you unprecedented power and analytical functions, outstanding reporting and presentation tools, and easy charting. Includes faster ways to work. Reviewers consistently choose Excel as the best spreadsheet for Windows. It's an *InfoWorld* Product of the Year!



Party Reason — Microsoft Word for Windows.™

The original word-processing application for Windows is still the best selling! Drag and drop text and graphics around the page for easy creation of professional-looking documents. Existing

WordPerfect® files (and other file

formats) are usable in Word. You can even type a WordPerfect command and see Word's equivalent command automatically demonstrated on-screen!

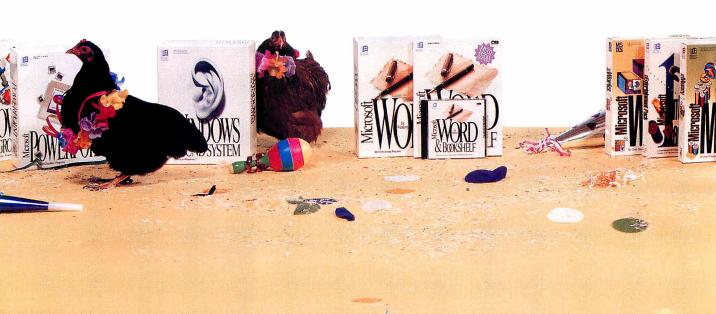
Party Reason — Microsoft Word and Bookshelf 92,® CD-ROM Edition.

The most popular word processor for Windows now becomes the ultimate writing tool with an entire electronic reference library full of multimedia sights and sounds! Includes dictionary, encyclopedia, thesaurus, atlas, quotations, and more.

Party Reason — Microsoft PowerPoint for Windows.™

For easy, professional on-screen slide shows, overhead transparencies or 35mm slide presentations. Fast and flexible word processing, graphing, outlining and drawing tools give you more time to master your content instead of wrestling with your software.





Choices To Crow About!



Project management is easier and more flexible than ever! This program gives you the power and versatility to manage your schedules and resources more efficiently. That's why *PC Magazine*, *PC Week*, *PC World* and *Software Digest* call Project the best program in its category!

Party Reason — The MS

Entrepreneur Pack.

Four great software packages in one! Microsoft Works,™ Publisher,™ Money™ and an Entertainment Pack.

Party Reason — Borland Paradox® for Windows.

Paradox for Windows is the relational database that makes a powerful database easy to use. Now you have complete access to data, plus all the tools you need to create graphical applications in no time. Paradox

for Windows works with existing Paradox for DOS and dBASE files without modification.

Party Reason — The Windows Programmer Pack.

Get everything you need to create programs for Windows: Microsoft QuickC for Windows,™ Visual Basic for Windows,™ Windows Control Development Kit,™ Windows Help Compiler™ and Windows Programmer's On-Line Reference.™

Party Reason — *Upgrade to the CD-ROM Edition of Microsoft Office.*™

You can upgrade from a choice of application software to Microsoft Office, CD-ROM version, for only \$99! This single package has all the leading Windows applications: Word, Excel and PowerPoint.

The standard edition of MS Office is also available as an upgrade from a choice of application software for \$175, or \$499 as a second application.

Party Reason -

Upgrade from Works to choice of application.

If the system you want comes with MS Works for Windows, you can upgrade to a choice of application software for only \$100.

Software shown here is sold only with the purchase of a system. Software sold with systems includes the identical applications contained in retail packages but will not include the retail box. You get all master diskettes and manuals, shrink-wrapped and packaged in a Gateway 2000 box.







The Whole Herd Is Dedicated To Prov

Yes, this is the whole gang at Gateway 2000. We now number in excess of 2,000 people. We gathered everyone together for this 486 Fest kick-off photo so you could see all the friends you have in the business, and so we could renew our commitment to your complete satisfaction.

Despite some blustery weather, Ted, our president and founder, gave us an inspiring pep talk about customer satisfaction and value. He reminded us that we will be the best in this industry only as long as we remember the guiding principles of our company, best described in our mission statement:

We are Gateway 2000.

We care about and respect you, our customers.

We pledge to you that we will be honest, courteous and friendly.

If we make a mistake, we will admit it.

If you're unhappy about something, we'll do everything in our power to make it right.

We'll treat you as an individual and take special care to see that your individual situation is handled fairly.

We have fun working together, striving to be the most knowledgeable, productive and successful team in the world. We blend our talents to continually offer higher quality, more innovative and useful products, at a value unmatched by competitors.

We will always be happy but we will never be satisfied.

And we will continually improve everything we do.

We will succeed, together as a team.

We are Gateway 2000.

We are the only logical choice!





ding You With The Best Service!



Each and every person in this photo rededicated his or her efforts to achieving these goals. Like a married couple going through a second wedding ceremony after many years of marriage, our energies were refocused on what's important. And what's important to us is *you*!

Party Reason — You get excellent after-the-sale support!

Every Gateway 2000 system comes with a **30-day money-back guarantee**. If you don't like your system, send it back within 30 days for a refund. All systems come with a **one-year limited warranty** and telephone **technical support** for the life of the system from our award-winning tech department. You also get an **automated fax service** to supply you with detailed documentation on over 150 technical

subjects, and a **lifetime BBS**membership for additional technical support and online forums.

We offer **on-site service** to most locations in the country (factory service only for notebooks). **Replacement parts** leave our factory as quickly as possible; we pay overnight shipping. Plus we now have **interactive documentation** on desktop systems with pictures and text right on your hard drive (in addition to comprehensive hardware and software manuals).

Party Reason — It's so easy! Just give us a call!

We make it easy for you to buy a Gateway PC, with convenient payment options including major credit cards and C.O.D. terms. Net 30-day terms and leasing options are also available to qualified commercial customers.



For a truly celebrated value, the choice is black-and-white: Gateway's 4DX-33.













Gateway 2000's Party List



4SX-25

- 25MHz 486SX Intel® Processor
- 4MB RAM
- 3.5" Diskette Drive
- 80MB 17ms IDE Hard Drive
- Local Bus IDE Interface
- Intel Pentium[™] Technology Ready
- Windows Accelerated Video w/1MB DRAM
- 14" Color CrystalScan™ 1024NI
- Mini Desktop Case
- 5 16-Bit ISA Slots
- 124-Key AnyKey™ Keyboard
- MS-DOS® 6. Diags, Windows™ & Mouse
- MS Works for Windows[™] 2.0

\$1295

- 33MHz 486SX Intel Processor
- 4MB RAM
- 5.25" & 3.5" Diskette Drives
- 170MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- Intel Pentium Technology Ready
- Windows Accelerated Video w/ 1MB DRAM
- 14" Color CrystalScan 1024NI
- Mini Desktop Case
- 5 16-Bit ISA Slots
- 124-Key AnyKey Keyboard
- MS-DOS 6, Diags, Windows & Mouse
- MS Works for Windows 2.0

\$1495

4DX-33

- 33MHz 486DX Intel Processor
- 8MB RAM, 64K Cache
- 5.25" & 3.5" Diskette Drives
- 212MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- Intel Pentium Technology Ready
- Windows Accelerated Video w/ 1MB DRAM
- 14" Color CrystalScan 1024NI
- Mini Desktop Case
- 5 16-Bit ISA Slots
- 124-Key AnyKey Keyboard
- MS-DOS 6, Diags, Windows & Mouse
- MS Works for Windows 2.0

\$1895

4DX2-50V

- 50MHz 486DX2 Intel Processor
- 8MB RAM, 64K Cache
- 5.25" & 3.5" Diskette Drives
- 212MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- Intel Pentium Technology Ready
- ATI[™] Ultra Pro Video w/1MB VRAM on VL-Bus"
- 15" Color CrystalScan 1572FS
- Desktop Case (Tower Upgrade)
- 7 16-Bit ISA Slots, 2 on VL-Bus
- 124-Key AnyKey Keyboard
- MS-DOS 6, Diags, Windows & Mouse

4DX2-66E

Windows Accelerated Video w/ 1MB DRAM

Choice of Application Software

66MHz 486DX2 Intel Processor

8MB RAM, 256K Cache

5.25" & 3.5" Diskette Drives

■ 500MB 11ms SCSI Hard Drive

Choice of Application Software

■ 32-Bit EISA SCSI Controller

4DX2-66 BEST BUY

- 66MHz 486DX2 Intel Processor
- 8MB RAM, 64K Cache
- 3.5" Diskette Drive
- CD-ROM Drive
- 340MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- Intel Pentium Technology Ready
- Windows Accelerator w/1MB DRAM on VL-Bus
- 14" Color CrystalScan 1024NI
- Desktop Case (Tower Upgrade)
- 7 16-Bit ISA Slots, 2 on VL-Bus
- 124-Key AnyKey Keyboard
- MS-DOS 6, Diags, Windows & Mouse
- MS Multimedia Works, CD-ROM Edition

\$2495

NOMAD 425SXL

- 25MHz 486SX Intel Processor
- 3.5" Diskette Drive
- Backlit 10" VGA Screen, 64 Gray Scale
- Simultaneous Video with 1MB
- Size 8.5" x 11" x 1.8," 5.6 Lbs.
- 6-Hr. NiCad Battery & AC Pack
- 1 Parallel / 1 Serial Port
- 79-Key Keyboard & FieldMouse"
- MS-DOS and Windows

- 4MB RAM
- 120MB IDE Hard Drive

- MS Works for Windows

\$1995



4DX2-66V

- 66MHz 486DX2 Intel Processor
- 16MB RAM, 256K Cache
- 3.5" Diskette Drive
- CD-ROM Drive
- 340MB 13ms IDE Hard Drive
- Local Bus IDE Interface
- Intel Pentium Technology Ready
- ATI Ultra Pro Video w/1MB VRAM on VL-Bus
- 15" Color CrystalScan 1572FS
- Desktop Case (Tower Upgrade)
- 7 16-Bit ISA Slots, 2 on VL-Bus
- 124-Key AnyKey Keyboard
- MS-DOS 6, Diags, Windows & Mouse
- Choice of Application Software

\$2995

NOMAD 450DXL

- 50MHz 486DX2 Intel Processor
- 3.5" Diskette Drive
- Backlit 10" VGA Screen, 64 Gray Scale
- Simultaneous Video with 1MB
- Size 8.5" x 11" x 1.8," 5.6 Lbs.
- 6-Hr. NiCad Battery & AC Pack
- 1 Parallel / 1 Serial Port
- 79-Key Keyboard & MS Ballpoint
- MS-DOS, Windows & Works for Windows

(With 4MB RAM and 120MB Hard Drive)

(With 8MB RAM and 200MB Hard Drive)

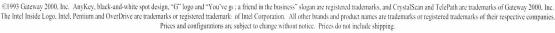
All hard drive sizes are manufacturer's specified

capacities. Microsoft MS-DOS 6 can increase hard drive capacity through software compression.

4 6 - 2 0 5 8

610 Gateway Drive • P.O.Box 2000 • North Gioux City, SD 57049-2000 • 605-232-2000 • Fax 605-232-2023 Sales Hours: 7am-10pm Weekdays, 9am-4pm Saturdays (CT)

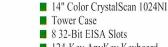


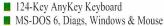






























Readers' Choice Awards

he votes are in. BYTE readers have once again picked their favorite hardware and software products. Some of the winners are perennial favorites; some are surprises. Some won by a nose. IBM's Think-Pad, for example, unseated the Mac PowerBook, last year's winner in the notebook category, by a slim three votes. Some mighty products slid out of the top three slots altogether: It's still the market leader, but Lotus 1-2-3 was the fourth pick of our readers, with only half the votes of Quattro Pro for DOS. This year, we've added a new category: Company That Provides the Best Service to Its Customers.

File Manager Disk Tree View Options Window Help CAPAINTER2N. File Edit Text Arrange Display Help 4 K Z uol Be 122 214 4 1 4 4 X 2 01a 428 Selected 1 file(s) (1,10) ter Darl 914 428 214 4×2 Parrie Carrier Microsoft Windows 3.1

These awards are important because they come from you, our readers. You use these products every day to do real work, in real working environments. The true test of a product's value isn't how many editors' awards it wins or how many boffo review blurbs it has in its ads, but how well it suits the needs of users. The winners on these pages are winners because they work for you; they help you get the job done.

HP LaserJet 4

HARDWARE PRODUCT OF THE YEAR

HP LaserJet 4.

Hewlett-Packard

RUNNERS-UP:

PowerBook Duo.

Apple Computer

Gateway 4DX2-66V,

Gateway 2000

DESKTOP COMPUTER — PC

Gateway 4DX2-66V, Gateway 2000

RUNNERS-UP:

Compaq ProLinea,

Compaq Computer

Dell 466/T, Dell Computer

DESKTOP COMPUTER — MACINTOSH

Mac Quadra series,

Apple Computer

RUNNERS-UP:

Mac IIvi, IIci, Apple Computer

WORKSTATION

IBM RS/6000.

IBM

RUNNERS-UP: HP 9000, Hewlett-Packard Iris Indigo, Silicon Graphics

LAPTOP/NOTEBOOK COMPUTER

IBM ThinkPad. IBM

RUNNERS-UP: Mac PowerBook, Apple Computer Mac PowerBook Duo, Apple Computer

HAND-HELD/PALMTOP **COMPUTER**

Gateway HandBook,

Gateway 2000

RUNNERS-UP:

HP 95LX. Hewlett-Packard Wizard, Sharp Electronics

MONITOR

MultiSync FG series.

NEC Technologies

RUNNERS-UP:

FlexScan T560i, Nanao USA ViewSonic 7, ViewSonic

LASER PRINTER

HP Laser.Jet 4.

Hewlett-Packard

RUNNERS-UP:

HP Laser.Jet IIIsi,

Hewlett-Packard

HP LaserJet IIIP,

Hewlett-Packard

MODEM

Practical Modem 9600SA,

Practical Peripherals

RUNNERS-UP:

Satisfaxtion 400e, Intel Optima 144+, Hayes

Microcomputer Products



VIDEO BOARD -

DOS/WINDOWS

ATI Ultra series.

ATI Technologies

RUNNERS-UP:

Stealth VRAM.

VGAWonder XL,

VIDEO BOARD -

Apple 24-Bit Color,

SuperMac Technology

Radius PrecisionColor,

ATI Technologies

MACINTOSH

RUNNERS-UP:

Apple Computer

Thunder/24.

Gateway HandBook

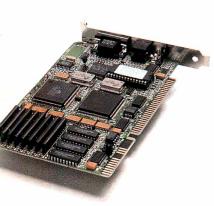
Radius

Diamond Computer Systems

MultiSync FG



Gateway 4DX2-66V



ATI Graphics Ultra



Mac Quadra 900

SOFTWARE

PRODUCT OF THE YEAR

Microsoft Windows 3.1,

Microsoft

RUNNERS-UP OS/2 2.0, IBM Quattro Pro for Windows. **Borland International**

WORD PROCESSOR —

Microsoft

WordPerfect 5.1, WordPerfect

WORD PROCESSOR -**MACINTOSH**

Word for Macintosh,

Microsoft

RUNNERS-UP:

WordPerfect, WordPerfect MacWrite II, Claris

CAD PROGRAM — **DOS/WINDOWS**

AutoCAD release 12, Autodesk

RUNNERS-UP:

Generic CADD.

Autodesk Retail Products DesignCAD 3D, American

Small Business Computers

CAD PROGRAM — **MACINTOSH**

Claris CAD,

Claris

RUNNERS-UP:

DesignCAD for the Mac, American Small Business

Computers Vellum, Ashlar

CONTACT MANAGERS/ PIMS

Lotus Organizer,

Lotus Development

RUNNERS-UP:

PackRat, Polaris Software ACT, Contact Software International

DATABASE MANAGER — DOS/WINDOWS

Paradox.

Borland International

RUNNERS-UP:

FoxPro, Microsoft Access, Microsoft

DATABASE MANAGER — **MACINTOSH**

FileMaker Pro.

Claris

RUNNERS-UP:

4th Dimension, Acius Omnis, Blyth Software

DATABASE CLIENT/SERVER

NetWare SQL, Novell

RUNNERS-UP:

SQL Server, Microsoft/Sybase Oracle Server, Oracle

DESKTOP PUBLISHING PROGRAM -DOS/WINDOWS

PageMaker, Aldus

RUNNERS-UP:

Ventura Publisher for Windows, Ventura Software FrameMaker for Windows, Frame Technology

DESKTOP PUBLISHING PROGRAM -MACINTOSH

PageMaker, Aldus

RUNNERS-UP:

QuarkXPress, Quark Ventura Publisher,

Ventura Software

DESKTOP PUBLISHING PROGRAM — UNIX

FrameMaker,

Frame Technology

RUNNERS-UP:

Interleaf, Interleaf

Island Write, Draw & Paint.

Island Graphics

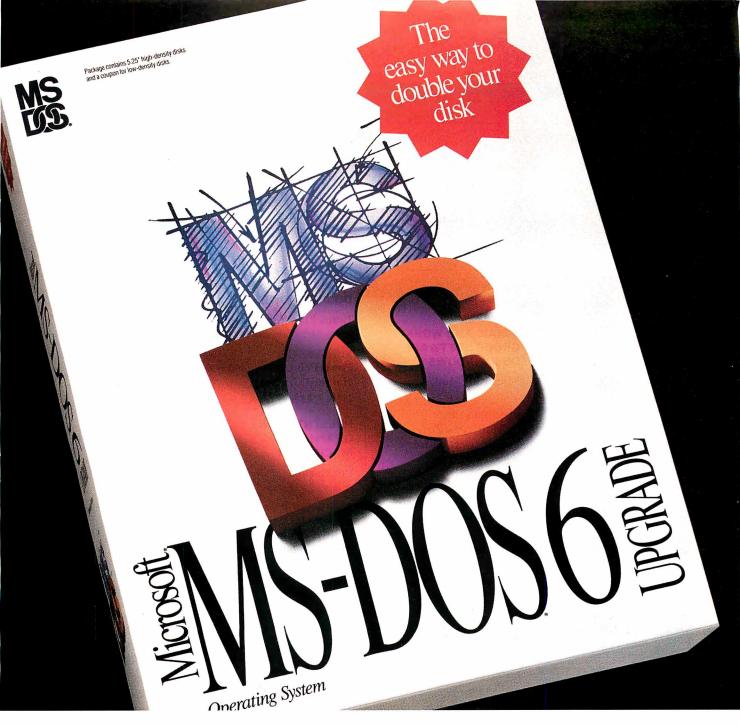
DOS/WINDOWS

Word for Windows,

RUNNERS-UP:

Ami Pro,

Lotus Development



YOUR HARD DISK JUST GOT DOUBLE THE ELBOW ROOM.

All those files and applications you've accumulated won't cramp your style anymore. Now our integrated disk compression doubles your disk space. Easily. Invisibly. Safely.

dblspace

And our improved memory

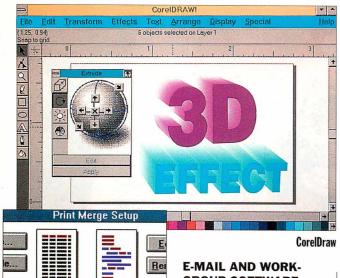
Simply type it in and your disk has double the space."

management lets you extend your memory with just a few keystrokes. We've even added great new features like backup, anti-virus and undelete tools for users of both MS-DOS* and Microsoft* Windows."

So if you need more space, integrated disk compression in the MS-DOS 6 Upgrade operating system makes it easy to stretch out.



Feature



Microsoft Word for Windows

Merge..

File Edit Search Run Compile Project Options Window d:\borlandc\classlib\source Object& Stack::pop() Objects temp = theStack.peekHead theStack.detach(temp); if(temp *= NOOBJECT) items!nfcontainer--; return temp; Spy View Tree Messages Overlapped 11AC (Progman) progmar

Borland C++

BYTE LA	PRODUC	REPORT	
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PageMaker 4.2

GROUP SOFTWARE — DOS/WINDOWS

Microsoft Mail. Microsoft

RUNNERS-UP: cc:Mail, Lotus Development WordPerfect Office. WordPerfect

E-MAIL AND WORK-**GROUP SOFTWARE** — **MACINTOSH**

cc:Mail.

Lotus Development

RUNNERS-UP:

Microsoft Mail, Microsoft QuickMail, CE Software

GRAPHICS PROGRAM — DOS/WINDOWS

CorelDraw.

Corel Systems

RUNNERS-UP:

Adobe Illustrator.

Adobe Systems

Designer, Micrografx

GRAPHICS PROGRAM — **MACINTOSH**

Adobe Illustrator,

Adobe Systems

RUNNERS-UP:

MacDraw Pro, Claris Canvas, Deneba Systems

NETWORK OPERATING SYSTEM - PC

NetWare, Novell

RUNNERS-UP: Windows for Workgroups,

Microsoft

LANtastic, Artisoft

NETWORK OPERATING SYSTEM — MACINTOSH

NetWare,

Novell

RUNNERS-UP:

AppleShare, Apple Computer MacTOPS, Sitka

PRESENTATION GRAPHICS — DOS/WINDOWS

Lotus Freelance Graphics, Lotus Development

RUNNERS-UP:

PowerPoint, Microsoft Harvard Graphics,

Software Publishing

PRESENTATION GRAPHICS — **MACINTOSH**

Persuasion,

Aldus

RUNNERS-UP:

PowerPoint, Microsoft Cricket Presents, Computer Associates International

OPERATING SYSTEM/ ENVIRONMENT

Microsoft Windows 3.1, Microsoft

RUNNERS-UP:

MS-DOS 5.0, Microsoft

OS/2 2.0, IBM

PROGRAMMING LANGUAGE -DOS/WINDOWS

Borland C++,

Borland International

RUNNERS-UP:

Visual Basic, Microsoft Turbo Pascal,

Borland International

PROGRAMMING LANGUAGE -**MACINTOSH**

Think C.

Symantec

RUNNERS-UP:

Zortech C++, Zortech HyperCard, Claris

PROJECT MANAGEMENT

Project for Windows,

Microsoft

RUNNERS-UP:

Time Line, Symantec

Harvard Project Manager, Software Publishing

SPREADSHEET -DOS/WINDOWS

Excel.

Microsoft

RUNNERS-UP:

Quattro Pro for Windows,

Borland International

Quattro Pro, **Borland International**

SPREADSHEET — **MACINTOSH**

Excel.

Microsoft

RUNNERS-UP:

Lotus 1-2-3 for Macintosh,

Lotus

Wingz, Informix

UTILITIES -DOS/WINDOWS

Norton Utilities.

Symantec

RUNNERS-UP:

PC Tools Deluxe.

Central Point Software **Norton Desktop for**

Windows, Symantec

UTILITIES — **MACINTOSH**

Norton/Symantec Utilities for Macintosh,

Symantec

RUNNERS-UP:

Mac Tools Deluxe,

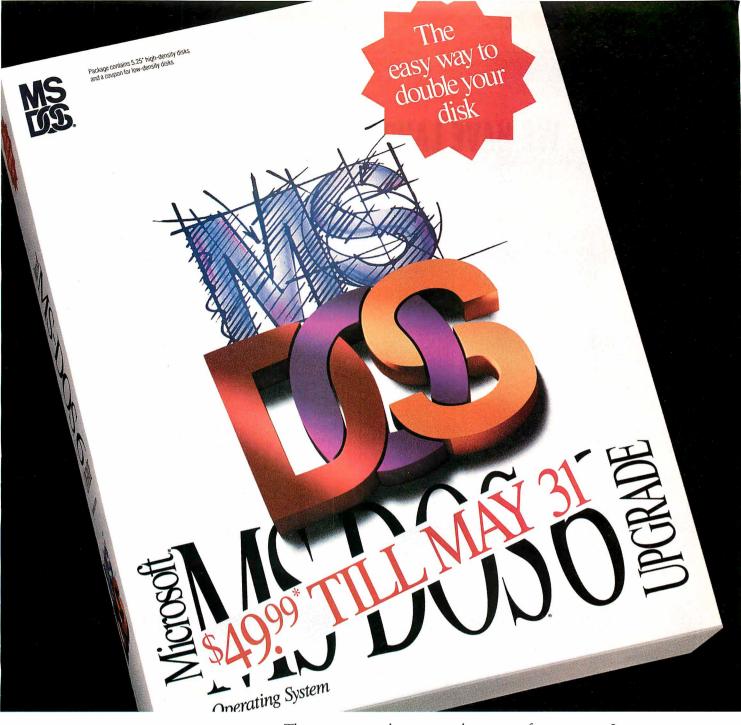
Central Point Software

SUM II, Symantec

COMPANY THAT PROVIDES THE BEST **SERVICE**

Gateway 2000

RUNNERS-UP: WordPerfect Microsoft



FOR A LIMITED TIME YOU'LL HAND OVER A LOT LESS.

This is your one chance to grab the MS-DOS* 6 Upgrade operating system at a price that's simply untouchable. Till May 31 you can get disk compression and improved memory management all for \$49.99.

Now integrated disk compression easily doubles the space on your hard disk.**And our improved memory management gives you

more free memory. In a snap.

To get information about this fantastic deal, call (800) 228-7007, Dept. RX3. Better yet, pick up the MS-DOS 6 Upgrade at your nearest reseller. Before this opportunity slips through your fingers.



WE HAVE LAURELS AT TOSHIBA, WE JUST DON'T







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Our T4400SXC, captured
PC Magazine's
Technical Excellence
and Editors' Choice
Awards, PC World's
World Class Award,
and Byte's Award
of Excellence.



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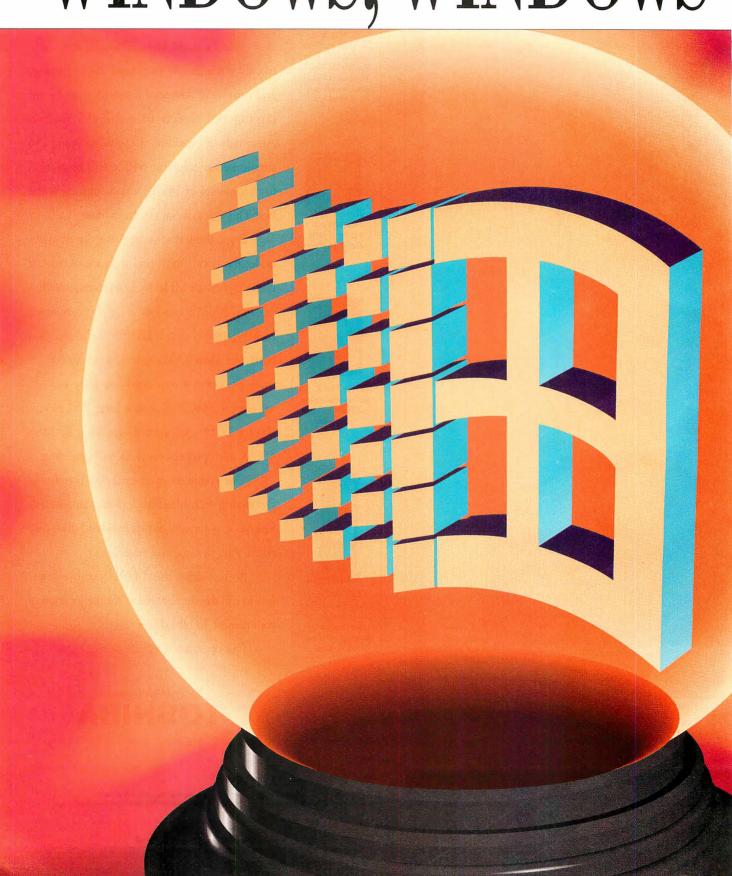
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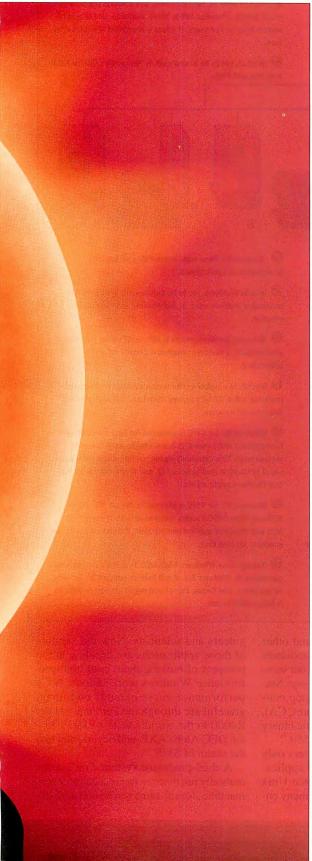
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Cover Story

WINDOWS, WINDOWS



EVERYWHERE?



If Microsoft has its way, one or another of its growing family of Windows operating systems will control everything from your cable TV box to your desktop PC, to your LAN, to your company's RISC-based multiprocessing superserver. The question Microsoft wants you to ask is not "Should I use Windows?" but rather "Which Windows should I use?"

JON UDELL

he chorus of voices asking the latter question swelled with the impending release of Windows NT. NT's advanced features are by now well known: microkernel architecture, portability, threaded symmetric multiprocessing, object-based security, and multiple operating-system personalities (see "Windows NT Up Close," October 1992 BYTE). Ironically, despite NT's considerable strengths, it could well be that a Windows 3.1 extender called Win32s (now shipping) or a more advanced 32-bit Windows-cum-DOS called Chicago (on the drawing board) will matter most to you.

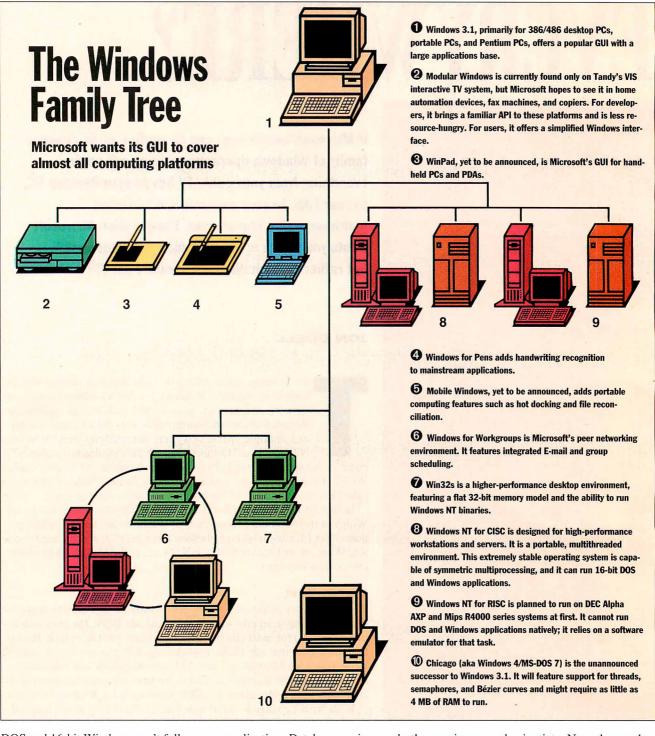
In this article, I'll answer the question Microsoft wants you to ask: Which of the 16- and 32-bit variants of Windows are best for which purposes? But I'll also answer the question that Microsoft doesn't want you to ask: When might Unix, or OS/2, or NetWare, or the Macintosh be a better choice than Windows?

Redefining the PC

The PC industry achieved startling progress in its first decade thanks to a pair of de facto standards—the IBM PC and MS-DOS. The term *personal computer* was, for most computer users, a synonym for an Intel 80x86—based machine that ran DOS. That definition began to change in 1990 when Windows 3.0 switched into 386 protected mode and delivered extended memory to the masses. Today the term *personal computer* is increasingly used to describe not a DOS machine but a Windows machine.

What hasn't changed—until now—is the Intel chip at the heart of a Windows machine. But when you use Windows NT to run Windows applications on a personal computer built around a Mips R4000 or a DEC Alpha AXP CPU, you're riding the next wave of PC hardware and software evolution. Systems designers, liberated by NT's HAL (hardware abstraction layer), are avidly exploring RISC and multiprocessor technologies along with innovative I/O architectures.

"The PC industry has been in a quandary because the only competitive weapon was price," says Bill Glazier, director of Windows NT marketing for Mips Technologies (Mountain View, CA). Glazier helped Mips launch the Open Design Center, which licenses design kits to vendors who want to build R4000-based PCs. Can this new species of RISC-based clone survive even as Darwinian forces thin the ranks of conventional clone makers? Yes, proponents argue, by evolving in directions that systems built for



DOS and 16-bit Windows can't follow.

The hardware competition that NT engenders—and, for users, the freedom of choice that it confers—goes far beyond the matter of RISC versus CISC. NT's arrival coincides with a generation of processors (including the Pentium, the R4000, and the Alpha series) designed to be yoked together in SMP (symmetric multiprocessing) systems. Built from the ground up to exploit SMP hardware, NT spells relief for the compute-bound Windows

application. Database engines and other server applications are obvious candidates for this treatment. "After porting our server to a stand-alone NT system," says Stuart Read, senior director of desktop marketing for Oracle (Redwood Shores, CA), "we were impressed that the same binary ran on NCR's eight-processor 3550."

Don't assume that SMP matters only for servers. Compute-intensive applications have put high-performance Unix workstations on the desktops of many engineers and scientists. Now the vendors of those applications are drooling at the prospect of moving them onto high-performance Windows workstations. NT's performance curve extends on a long, graceful arc through the Pentium and the R4000 to the world's fastest RISC CPU, the DEC Alpha AXP, and beyond that into the realm of SMP.

A dual-processor system won't automatically run twice as fast as a uniprocessor machine, for the same reason that a 32-bit

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Cover Story

program won't automatically double the speed of a 16-bit one. Performance can't scale linearly unless CPU throughput does, and processors already tend to leave their I/O subsystems in the dust. Fortunately, NT's clean separation from its supporting hardware encourages the sort of innovative design needed to break that logjam.

All in the Win32 Family

I have been writing Windows programs portably since Windows 3.1 came out. Originally that meant you could compile a single source file one way for Windows 3.1 and another way for Windows NT. Then a third target appeared: Win32s. Like the Windows extenders offered by Watcom and Rational Systems, Win32s gives Windows programs running on the 3.1 kernel access to linear 32-bit memory. Unlike these other extenders, however, Win-32s runs NT binaries. It can't supply all the advanced NT features-threads, security, Bézier curves—that are missing from DOS and Windows 3.1. In fact, apart from the Win32 memory management APIs, it supplies virtually none of those advanced features.

Despite this deficiency, for which its name apologizes (the s denotes subset), Win32s will find many more users this year than will Windows NT. To see why, consider Spatial Technology's (Boulder, CO) ACIS, a 3-D modeling and rendering engine that grew up in the 32-bit Unix environment. Spatial is developing the Windows version of ACIS on Windows NT, but founder Dick Sowar is clear about where his market is. "We'll have some NT sales, but our primary focus is Windows 3.1," he notes. "We run a lot faster on 32s than we do under NT on the same hardware. And it's an environment that's immediately available to more than 10 million Windows 3.1 users. We'll ship ACIS on 32s as soon as it's available." Mathcad from MathSoft (Cambridge, MA) will be another early Win32s adopter.

Who needs NT, then? Consider another Unix-based engineering application being readied for NT, Pro/Engineer from Parametric Technology (Waltham, MA). Win32s does provide linear memory, says vice president of development Mike Payne, "but to handle our 17 MB of code you need a real virtual memory manager, not the poor excuse you find in Windows 3.1." Payne says the Win32 version of Pro/Engineer performs well under a beta version of NT on both Intel and R4000 hardware, and he expects it will take a growing share of sales relative to the Hewlett-Packard, Silicon Graphics, and Sun versions.

NT has more going for it than a better virtual memory manager. After running it for many months, I've concluded it's the most robust system I've used since VMS. That's no coincidence, since NT lead architect David Cutler ran the VMS development effort while at DEC and then brought his team with him to Microsoft. A company that's betting its business on

an application probably shouldn't construct it on a sandy DOS/Windows foundation. The choice then becomes Unix, OS/2, or NT. All have the credentials to handle the job.

The lure of NT is source and binary compatibility with Windows 3.1. NT handles Windows binaries better than the others, because it maps Windows API

calls directly into the Win32 subsystem. That means 16-bit binaries spend a fair chunk of their time running in native Win32 mode on CISC or RISC platforms. If you decide to convert a Windows 3.1 program into a Win32 program (and if you've followed some simple portability guidelines), you'll spend more time writing a new make file than you'll spend editing code.

A PC in a Workstation

While Windows itself is arguably no better a GUI than X/Motif or OS/2's Presentation Manager, moving a line-of-business application onto a capable Windows platform such as NT offers distinct advantages. Companies that deploy workstations today typically find PCs popping up alongside those workstations. Why? When they are not trading stocks or doing finite element analysis or designing circuit boards, these people want to write letters and run personal schedulers—and they seem to want to do these things in Windows.

That's one reason Intergraph (Huntsville, AL) is porting NT to its RISC-based Clipper workstation line, as well as porting its entire suite of CAD/CAM applications from Intergraph's proprietary Unix to Windows. "It's interesting that the solution to merging the functions of a workstation and a PC into one box is turning out to be a down-market approach [Windows] instead of an up-market one [Unix]," says public relations director Jim Ruester.

The move to NT does a number of other important things for the world's fifthlargest workstation maker. NT opens up Intergraph's Clipper, which has been labeled a closed and proprietary RISC architecture. It also radically simplifies Intergraph's mission to move its software onto Intel and alternative RISC platforms. The reliable sameness of NT means Intergraph can diversify its hardware platforms without hacking through a forest of differing Unix APIs.

Who Needs Windows NT?

who need a stable platform on

Windows applications and 16-bit

DOS and Windows applications

LAN administrators

who need a robust, scalable

server applications

which to multitask 32-bit

Power users

Moreover, Windows' rich environment will be fertile ground for Intergraph's software. "All kinds of useful spin-offs can happen when you put the engineering software side by side with the business and personal productivity applications," says Tom Steele, Intergraph's executive vice president of software systems. "An

platform for use with 32-bit OLE that's attached to a spreadsheet is very interesting to us." He adds that the messaging and peer-networking technology that NT shares with Windows for Workgroups will slide neatly underneath the workflow features in Intergraph's applications suite.

Chicago and the Fear of OS/2

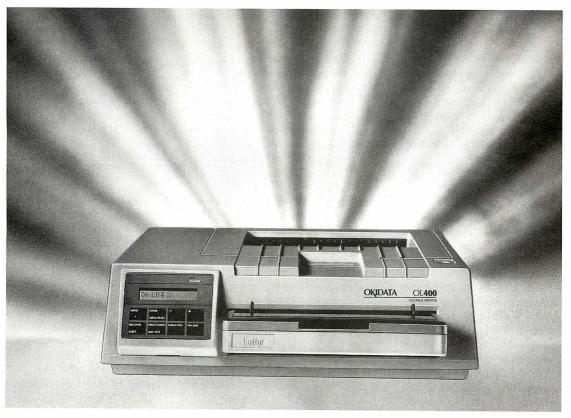
Lurking offstage is an even newer Windows sibling, an integrated DOS/Windows system called Chicago (aka Windows 4/MS-DOS 7) that will run yet another variant of the Windows API, Win32c. Details are sketchy; Microsoft understandably doesn't want to sabotage NT's moment of glory. Sources reveal, however, that Chicago is precisely the sort of "NT Lite" that Microsoft claims it is not.

Indications are that Win32c will occupy a midpoint along a curve that connects Win32s to Win32, supporting threads, semaphores, and Béziers but not Unicode or security. By sacrificing portability and the SMP option, this new 32-bit Windows will target 80x86 processors and the Pentium in configurations as lean as 4 MB.

For some software developers who were badly burned by Microsoft's handling of OS/2, Windows NT (in light of Chicago) creates a disturbing sense of déjà vu. "OS/2 was the direction," says one prominent tool vendor, "and then they made Windows better and killed it. Now NT's the direction, and here they go making Windows better again."

But other observers relish the prospect of an API that's fuller than Win32s and bound to a more capable low-end Windows. Spreading Windows more smoothly

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Mips Challenges Intel on Its Own Turf

TOM R. HALFHILL

ips Technologies (Mountain View, CA), a relatively small chip-design house owned by Silicon Graphics, hopes Windows NT will enable its highly regarded RISC processors to challenge Intel's decade-long grip on the mass market for PCs. Raw speed isn't a problem for Mips processors. The clock-doubled 50-/100-MHz R4000, which costs about the same as a 33-MHz Intel 486 (around \$400 in 1000piece quantities), runs two to four times as fast. The 75-/150-MHz R4400, scheduled for volume production in June, costs about the same as a 66-MHz Pentium (less than \$1000) and runs about twice as fast as Intel's flagship processor.

Today, Mips's processors are a trickle in the torrent of 80x86-compatible chips entering the PC market every year. Intel's high-volume manufacturing facilities ensure a healthy supply of chips, and its competitors (AMD and Cyrix) help keep prices in check. Mips has responded by licensing production of the R4000 series to six independent suppliers: Integrated Device Technology, LSI Logic, NEC Electronics, Performance Semiconductor, Siemens Components, and Toshiba.

Even if Mips can get supply and price under control, it's going to be hard to convince PC clone makers that a RISC PC is viable. Designing new systems around high-speed RISC chips is a daunting task. Many PC vendors weakened by last year's price wars can no longer afford major R&D efforts.

Mips Sowing Seeds

To seed the development of R4000-based systems, Mips recently founded the ODC (Open Design Center) in Mountain View. The ODC sells design kits that enable cloners to jump from using an 80x86 to using the R4000. One kit includes a reference motherboard for building systems specifically tuned to Mips processors; another has an under-\$20 pair of ASICs (application-specific ICs) that allow vendors to adapt the

R4000 to existing 486 motherboards. Either way, just add memory, peripherals, and Windows NT, and you've got a complete R4000 system that Mips suggests will be a Pentium killer.

One of the ODC's first customers is Carrera Computers, a start-up company in Laguna Hills, California. In February, Carrera began selling R4000 motherboards based on one of the ODC's reference designs. Sized to fit standard AT cases and intended for high-performance workstations or servers, the \$4995 board includes a 1280- by 1024-pixel local-bus video controller, 2 MB of VRAM (video RAM), SIMM slots for memory expansion to 256 MB, four EISA slots, a SCSI-2 connection, an Ethernet port, parallel and serial ports, and PS/2-standard keyboard and mouse ports.

Carrera founder and chairman Bruce Faust believes that PC vendors will adopt RISC because it is economically sound and technically painless. While Carrera's motherboard complies with the ARC (Advanced RISC Computing) specification, he says that in the long run "ARC won't matter a hill of beans." ARC features, such as an EISA bus, SCSI, and built-in networking, can be omitted from the kind of bare-bones boxes that PC clone vendors like to sell. In fact, Carrera is working on a lowerpriced R4000 motherboard that does just that. Faust claims that by the end of this year you'll be able to buy a \$3500 RISC PC that delivers four times the performance of a 66-MHz 486DX2.

Acer Develops PICA

Ronald Chwang, CEO of Acer America (San Jose, CA), makes a similar claim. Acer, however, is taking a very different approach. Rather than adopting a Mips reference design, the company has developed a new system architecture called PICA (Performance-Enhanced I/O and CPU Architecture). "As CPU power continues to increase," says Chwang, "you must innovate to bring I/O bandwidth into balance with it. NT encourages us to do that."

At the core of Acer's minicomputerlike design is a 64-bit, 200-MBps bus connecting the R4000, memory, video, and a 64-bit, four-channel I/O processor that gives each channel independent DMA and bus-mastering capability. Integral Ethernet and SCSI I/O attached to those channels goes faster than it would on an EISA bus, and the design eliminates the prohibitive cost of EISA bus-mastering logic. A standard AT-bus controller does, however, support ISA cards

PICA chip sets and motherboards not only will be found in Acer systems, but also will be licensed to other vendors through the ODC. A typical configuration may include a 50-/100-MHz R4000 chip, 16 MB of RAM, a 200-MB SCSI hard drive, a CD-ROM drive, a floppy drive, an accelerated video card on the video bus, built-in Ethernet, and a SCSI-2 port. The cost of such a configuration will be around \$3500 (not including monitor).

PICA will compete with another new post-AT architecture—Intel's PCI (Peripheral Component Interconnect). Not simply a rival to the VL-Bus local-bus standard, PCI is actually a sweeping next-generation system architecture that just happens to support ISA and EISA for backward compatibility with old expansion boards. Like Acer, Intel offers a complete chip set that makes it easier for PC vendors to implement the new architecture; like Mips and the ODC, Intel is offering a reference motherboard that anyone can copy or modify.

A significant difference between PCI and PICA is that Intel's PCI supports any microprocessor, even non-80x86 and non-Intel chips. The current version of Acer's PICA works only with the Mips R4000 series, although Acer says future versions could support other chips as well. What PCI and PICA have in common is high performance, backward compatibility with the familiar AT bus, and a balanced approach to system architecture.

Windows NT is shaping up as the battleground not only for next-generation microprocessors, but also for next-generation PC system architectures.

Tom R. Halfhill is a BYTE senior news editor. You can reach him on BIX as "thalfhill."

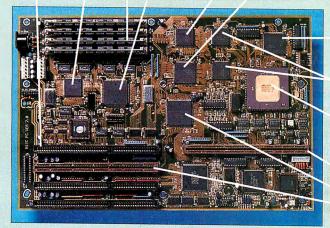
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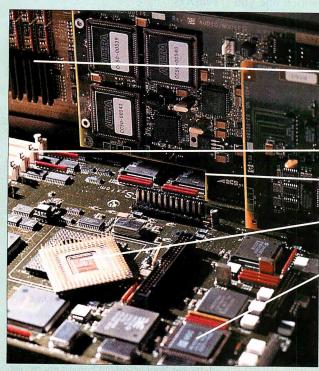
32-bit data path parts

50-MHz Mips R4000

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The PICA Mips motherboard.



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across the hardware spectrum will only enhance NT's prospects, according to this view. "We were tickled to hear about Chicago," says one developer, "although we can understand their need to downplay it right now, because it sure might confuse people about NT."

Choosing Appropriate Technology

The "Windows everywhere" strategy, insofar as it unites systems ranging from laptops to superservers, makes a great deal of sense. DOS and Windows will continue to dominate at the low end. They're appropriate technologies for today's laptops and for some desktop systems. On the desktop, however, the boundaries will blur. Windows 3.1 (with or without Win32s), Chicago, and NT will each find a niche, determined by your hardware resources and your needs and preferences.

My 8-MB 386/25 runs Windows for Workgroups and Win32s nicely, and I expect it will handle Chicago just fine also, but I wouldn't burden it with NT. My 16-MB 486/50, on the other hand, is a good NT machine. Using it as a workstation, I appreciate its stability and responsive multitasking. I also use it as a file server and as a platform for SQL Server.

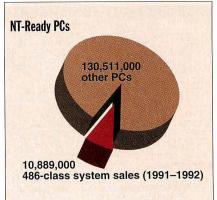
A beta version of SQL Server runs on my NT machine now, but for some months before it was available I ran the shipping version of SQL Server 4.2, which is an OS/2 application—and a demanding one, too. I never really expected that NT's OS/2 emulator could rise to the occasion. Amazingly, it did, and I then used that configuration to test a series of SQL Server clients. Microkernel theory says that if memory management, thread scheduling, synchronization, and other services are implemented correctly, the microkernel can support any advanced operating system in a robust manner. My experience with NT's OS/2 subsystem suggests that the theory is correct, and it hints at the power and flexibility of NT.

So is NT for workstations or for servers? I say both. Clearly it's a server platform. But I also believe that my mission is as critical as a server's. Therefore, I'll use NT (hardware permitting), because

when Windows 3.1 suffers from one of its unpredictable seizures, I waste time reestablishing my context and sometimes lose data. Obviously, NT's appetite for hardware—on Intel platforms, you'll want 12 to 16 MB of RAM and a 486-precludes that choice for most users today.

Even if you can run NT, however, you might opt to trade its stability (which costs you system overhead) for the speed you could wring out of Windows 3.1 running Win32s applications on the same hardware. The point isn't which one you choose, but simply that you have a choice. A wide selection of Windows applications will be available everywhere, because their common API invites them to migrate freely among Windows platforms.

Microsoft argues, with some justification, that the common API will also ease the development of client/server applications. Today such applications often



Dataquest estimates that nearly 11 million 486-class PCs were sold during 1991 and 1992. This represents a mere 7.7 percent of the installed base of PCs still in use that could be NT-ready. An undetermined number of those 486 systems, however, are unable to run Windows NT without memory or storage upgrades.

span Unix, OS/2, or NetWare servers and Windows clients. That forces developers to grapple with two hairy APIs instead of one. "It's not an issue if you are using packaged server software," says Oracle's Read, noting that many TCP/IP products for Windows support the use of Unix-based Oracle servers, "But if you are doing your own client/ server development,

then yes, the common API will save you headaches."

Pen Computing with Windows

When was the last time you saw someone using a pen-based system on an airplane? The typical user of a pen system today might be walking along a highway inspecting power lines for Detroit Edison or taking inventory in a K-Mart warehouse. The system of choice for these mobile data-collection tasks is a GridPad running PenDOS.

Waiting in the wings are two elegant solutions in search of a problem: Microsoft Windows for Pens, and PenPoint from Go Corp. Microsoft's rather nifty extension to Windows 3.1 defines an evolutionary path from mainstream Windows applications to pen-enabled ones, to fully pencentric ones. Go's revolutionary PenPoint forgoes continuity with the desktop and invents its own arguably superior notebook user interface. Unfortunately, neither approach matters much to a Detroit Edison power-line inspector, whose reaction to the Microsoft mantra "Windows everywhere" would probably be "Huh?"

There may yet be a role for pen or tablet systems that run mainstream text, graphics, spreadsheet, and database applications, as distinct from PDAs (Personal Digital Assistants) used for scheduling and communication. Think of the pen system as a yellow legal pad and the PDA as a pocket calendar; you have one of each and use them at different times for different purposes. If pen systems go horizontal, Windows for Pens stands to benefit enormously from its family connections. It adds value to standard Windows software running on a pen system, and it offers developers of pencentric applications a familiar

Windows Weaknesses **Lacks vector** Not yet well-WEAKNESS No distributed **GUI** not fully integrated with and polygon integrated for global directory operating primitives and portable systems service to track 2-D/3-D system network programming resources abstractions **Specialized Unix** Mac NetWare, Vines, WHO DOES workstations IT BETTER? Unix

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Many Processors, Many Threads

BOB RYAN

hat one processor can do, two can do faster, and three can do even faster than that. That's multi-

processing theory. Between theory and working multiprocessor systems, however, lies a gulf that can be bridged only by some complex and expensive technologies. Shared memory buses and cachecoherency protocols have been in use for many years and have found their way into a number of commercial computers, but as yet multiprocessing hasn't had much of an impact on the marketplace.

Windows NT may well change all that. According to Tom Hiel, systems engineer of NCR's multiprocessing product group, "The key enabler of multiprocessing is an operating system that delivers it." NCR, which was to unveil a line of Pentium-based multiprocessing machines in May, expects healthy competition. AST Research, Compaq, Sequent, Siemens Nixdorf, and Wyse are among the companies that will introduce NTbased symmetric multiprocessing systems. These companies and others expect NT to jump-start the multiprocessor market.

For NT, a uniprocessor machine is a degenerate case. Built from the ground up for SMP (symmetric multiprocessing), the NT kernel simply allocates threads to as many processors as are available. In a four-processor machine, the four highest-priority threads will always be running simultaneously. The kernel tracks threads that are ready to run along with their associated priorities, and it automatically handles multiprocessor load balancing.

This approach differs from how Unix systems—except Mach-based ones—deliver multiprocessing sup-

port. SCO Unix and Unix System V release 4.0 achieve multiprocessing by means of kernel extensions. According to Mike Flanary, senior product manager for the Workstation Division at NCR, NT's built-in multiprocessing ports more readily and runs faster than

Multiprocessing NT systems employ a shared-memory architecture where each CPU has equal access to the common memory store. Cache-coherency protocols ensure that processors accessing the same memory locations have the most up-to-date version of the common data in their caches.

the bolt-on kind.

The key to NT's multiprocessing support is its HAL (hardware abstraction layer). The HAL provides the kernel with a consistent view of the hardware, whether the system has one processor or 10. Different hardware doesn't require a different kernel, only a different HAL. All NT applications that run on a uniprocessor system will run on a multiprocessor system. "The HAL is the device driver for the box," says Dave Becker, manager of server marketing at Wyse (San Jose, CA).

NT can't handle all multiprocessing hardware; it supports symmetrical mul-

tiprocessors only. The system must support cache coherency at the hardware level, and individual processors must be able to run any thread and service any interrupt or exception. This latter condition has an interesting side effect. Even if your application is not multi-

threaded, it can still get a boost from multiprocessing hardware, because NT system threads such as I/O service routines can run in parallel with the application code.

What's involved in writing a HAL? According to Becker, it takes about 20,000 lines of C code. NCR's Flanary says that writing HAL code is the majority of the work required to port NT.

Most multiprocessing systems will be sold as expensive highperformance servers. Sequent, for example, will play prominently in that market. Some companies, however, see an important role for multiprocessing desktop machines. NCR in particular plans to target compute-bound desktop applications, such as CAD, imaging, and desktop publishing, with its Pentium multiprocessors. Wyse also sees a role for SMP on the desktop, especially in engineering workstations. "The final nail in the coffin of workstation/PC differentiation is a local-

bus [multiprocessing] PC running NT," says Becker.

The multiprocessor vendors believe they can compete against hot uniprocessing workstations. The Alpha series, Mips R4x00MC, and Pentium chips all accommodate multiprocessor designs, so "it all comes down to cost/performance," says NCR's Flanary. NT gives multiprocessing vendors a platform that lets them innovate for performance while maintaining compatibility with a large software base.

Bob Ryan is a BYTE technical editor. You can reach him on BIX as "b.ryan."

programming environment. However, in a pen market dominated by field data collection, these synergies aren't very compelling.

Let's Get Small

Synergies are even harder to nail down in the case of the junior member of the Windows family, Modular Windows. Executing in a megabyte of ROM on Tandy's Video Information System (a 286-based CD-ROM player), Modular Windows displays on your TV and takes input from an

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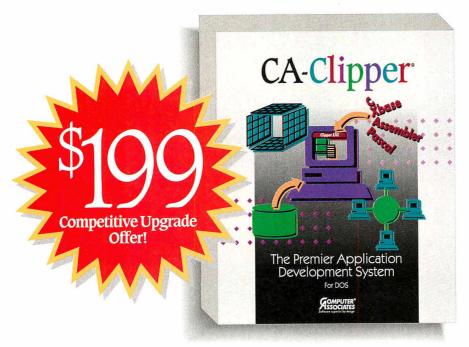
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Customizable Reactive Error Handling	YES	NO	NO
Reads and Writes FoxPro (.CDX) Files	YES	YES	NO
Reads and Writes dBASE IV (.MDX) Files	YES	NO	YES
Reads and Writes Paradox (.DB/.PX) Files	YES	NO	NO

Comparison based on FoxPro Version 2.5 for DOS and dBASE IV Version 1.5.

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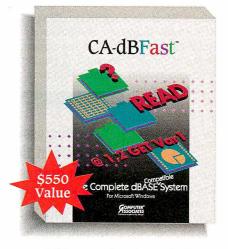
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Cover Story

eight-button hand controller. It jettisons large chunks of Windows, including Program Manager, multitasking, overlapped windows, and menus, in order to meet two requirements: stuff Windows into a megabyte, and simplify its GUI for the interactive TV user. What's left is about two-thirds of the Windows API plus an assortment of user-interface controls (cartoon-like buttons and scroll bars) and APIs (for managing the hand controller, direct video access, and the Tandy VIS memory cartridge).

A Modular Windows program bears a family resemblance to a regular Windows program, but the two are cousins once removed. The Modular Windows Software Development Kit comes with a version of the Reversi game that compiles for both platforms, but only thanks to large chunks of conditional code that are specific to Modular Windows. The adapted Visual Basic included with the SDK can help smooth over the differences, and Microsoft's latest multimedia authoring toolkit will build reference titles for Modular Windows, Windows 3.1/MPC, and Sony's MMCD Player from a single set of assets. Despite these aids, however, developers targeting the home entertainment market may ultimately find Modular Windows'

relationship to Windows less useful than Microsoft claims, just because TVs and computers are still very different animals.

The value of the relationship gets even more tenuous if you imagine, as Microsoft does, that Modular Windows will be used to control intelligent cable boxes, high-end fax machines and copiers, and home automation systems. Microsoft won't say who's experimenting with Modular Windows for these purposes, and none of the likely candi-

dates are talking, either.

Even though these kinds of devices won't run anything that's remotely like standard Windows applications, Craig Mundie, Microsoft's general manager for advanced consumer technologies, claims their relationship to Windows is critical.

He cites familiar programming tools and procedures as factors that will speed Modular Windows-based software's time to market. Perhaps, but Windows has by no means yet proved that it can effectively serve that market. "We have a hard enough time even getting our customers to consider DOS," says Vincent D'Amico, director of software development for MicroTouch (Wilmington, MA), a touchscreen manufacturer focused on gaming and point-of-sale applications.

While the lone example of the Tandy VIS running Modular Windows isn't much support for sweeping claims about Windows' downward scalability, Microsoft is pursuing a series of initiatives to further shrink Windows and adapt it for nomadic use. T

adapt it for nomadic use. There's no time to lose. It is hardly an accident that the Mac PowerBook has become the mobile

machine of choice for the traveling businessperson. With its compelling combination of ROM-resident software, elegantly built hardware, and easy-to-use fax and remote networking, the PowerBook defines what the portable Windows machine has yet to achieve.

Microsoft reportedly has yet other versions of Windows for portable systems in the works. Mobile Windows, or MobiWin for short, is targeted at notebooks and subnotebooks. It will add features such as hot docking, which automatically synchronizes

the configurations of both the computer and the docking station, and file reconciliation to the standard Windows, according to Gerry Purdy, vice president and chief analyst for mobile computing at Dataquest (San Jose, CA).

WinPad is a GUI for hand-held PCs. It

"If I had a gun I'd shoot my PC; it can't even do a 20-page newsletter without having a spasm. I grew up with real systems, like VMS. If that's what Microsoft has in NT, I'm all for it."

Nina Lytton, editor, Open Systems Advisor (Boston, MA)



uses what Purdy describes as "elevators and floors." For example, on the desktop you have the real estate to manage tiling Windows. When the screen gets small, you don't have that luxury. So, instead, you stack the windows, one on top of the other, and select them by choosing "elevator" buttons.

Cracks in the Continuum

What "Windows everywhere" mostly means, for now, is that Windows runs both workstation and server applications. Microsoft also wants Windows to run your network, but that's easier said than done.

Despite the nifty workgroup capabilities of Windows for Workgroups and Windows NT, you can't get full-blown enterprise networking with just one stop at the Microsoft shop.

What's missing? Most notably, a distributed global directory service that tracks all of an organization's human, hardware, and software resources. Also, Windows has no directory service. Even the advanced NT server, which will implement LAN Manager—style replicated administrative domains and support authentication between "trusted domains," won't match the capabilities of Novell's Net-Ware Directory Service, Banyan's Street-Talk, or the ONC-style (Open Network Computing) and DCE-style (Distributed Computing Environment) directory services sweeping the Unix community.

"NT will have a domain-based name service," says Jamie Lewis, an analyst for the Burton Group (Salt Lake City, UT), "but not a true global directory." NT's support for DCE RPCs (remote procedure calls) enables developers to distribute services across a mixture of NT and Unix platforms, but how will those services be advertised and located? NT won't initially support the DCE directory service. Cairo, a future version of Windows that's being designed to weave OLE, RPCs, and the NT file system into a distributed object system, won't solve the directory problem anytime soon.

Add to this technical challenge Microsoft's historical inability to sell network software to corporations, which is shown once again by WFW's lackluster sales performance. In fact, WFW is an under-

"As Microsoft crams more and more of the network into the operating system, the distinction between client and server gets harder and harder to tell. This is threatening to Novell. The camel's nose is in the tent."



Paul Giraldi, vice president of sales, Valinor, Inc. (Fort Lee, NJ)

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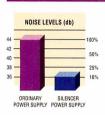
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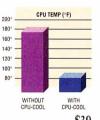
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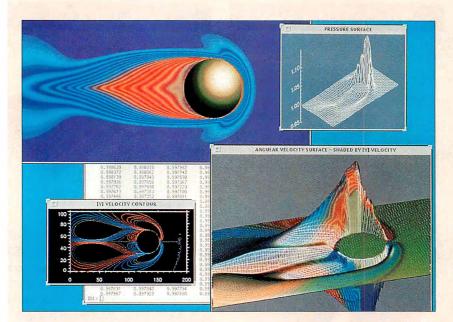
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Windows graphics still lag, but not for long



Despite Windows' graphical face, its raster-based GDI (Graphical Device Interface) lacks the vector and polygon primitives and the 2-D/3-D programming abstractions necessary for advanced illustration, CAD/CAM, and visualization applications. Such primitives and abstractions serve two purposes: They simplify programming, and they create hooks for vastly better hardware support than today's local video buses and Windows accelerators can provide.

NT's GDI enhancements—paths, Bézier curves, 2-D transforms—help only slightly. Windows can enter the 3-D graphics workstation arena riding on the shoulders of NT, but to compete successfully there, it needs to grow a better graphics API.

The good news is that Microsoft has licensed Silicon Graphics' renowned OpenGL. The bad news is that it won't be included in the first release of NT. Microsoft and Silicon Graphics are working to integrate OpenGL with GDI, but that's a complex task that will probably occur in stages. Some vendors can't wait. "We'll have an OpenGL interface in our first release," says Intergraph's Tom Steele. NEC Technologies (Boxborough, MA) will also offer OpenGL support for its forthcoming

The Windows GDI is not well suited for applications such as this simulation of airflow around a sphere, shown running on a RISC platform. (Photo courtesy of Research Systems, Boulder, CO)

R4000-based NT workstation.

Mike Mitsch, group manager of computer systems marketing for NEC, sees a strong need for commercial OpenGL-based software, even on hardware that doesn't have a graphics pipeline. "Brokers want to visualize the behavior of hundreds of stocks along multiple dimensions, and GDI just wasn't built that way," he says.

Win32 applications that adopt OpenGL will be able to do such things with relative ease, and on platforms that accelerate OpenGL, they'll do them in real time. Board-level OpenGL accelerators for RISC PCs are one likely development. If GDI and OpenGL do merge successfully—and Bill Glazier of Mips emphasizes that "we're not going to accept any kludged solution"—NT could well become a highly strategic operating system for Silicon Graphics workstations.

The fact remains that NT won't deliver high-performance graphics in its first release. But no one's complaining bitterly, either. System builders and software developers think that the Microsoft/Silicon Graphics relationship is taking NT graphics in the right direction.

appreciated gem. MIS people who gave it a bad rap, fearing the peer server would compromise centralized data management, missed the point completely. The server is an optional convenience.

The real value of WFW lies in the work-group pieces, such as Mail, Schedule+, and MAPI (Messaging API), that can add complementary (and centrally manageable) services to an existing server-based LAN such as NetWare. Why wasn't this message ever heard? No one delivered it. Microsoft lacks Novell's army of resellers and Sun Microsystems' battalion of direct salespeople.

In the case of NT, the message is even more compelling. The basic product, for example, bundles a remote-access service that handles asynchronous and even X.25 connections. The X.25 support is particularly important to any company that wants to export network services worldwide using a packet-switched network. "But no matter how good NT's networking may be," says Lewis, "Microsoft won't make a dent in Novell's business until it builds its own channel."

United Unix

Leading Unix vendors, including HP, IBM, The Santa Cruz Operation, Sun, and Univel, recently linked arms and proclaimed an end to the windowing and network wars that have splintered the Unix community. All these vendors now promise to ship X Window System 11 and Motif, along with

ONC, DCE, and the NetWare client protocols. "We'll finally be dealing from the same source base," says Dave Taber, group marketing manager for SunSoft (Mountain View, CA). It may be ironic that only the specter of NT could precipitate this long-overdue move, but the fact remains that a united Unix—if it materializes—will be a force to reckon with.

NT lacks Unix's multiuser foundation and its ability to export both character-mode and graphical interfaces through asynchronous and network connections. A third party, Citrix Systems (Coral Springs, FL), will add these capabilities to NT—as it has already done admirably for OS/2—but they're not part of the basic NT product. Although NT does maintain

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a database of users to support its role as a peer server, Citrix's multiuser version of NT is a major undertaking that upgrades NT's user and session management, optimizes its scheduler, and implements protocols for charactermode and graphics terminals.

If Microsoft can fairly claim that Unix wasn't built from the ground up for symmetrical multitasking, Unix vendors can with equal fairness point out that NT wasn't built to support multiple users logged in from remote terminals. If you think that's irrelevant in the 1990s, try selling your local video store an upgrade from Xenix to a Windows LAN.

Unix also owns the high ground in networking and distributed computing. NT owes its favorable reception among network cognoscenti largely to its adoption of Unix network protocols such as TCP/IP, sockets, and DCE RPCs. However, Windows networking is still biased toward the nonroutable NetBEUI protocol, and it has a long way to go before it can match the sophistication and worldwide reach of Unix networking.

The IBM Factor

Like Microsoft, IBM will field a family of nonportable and portable operating systems. "With such a wide range of hardware available," says John Soyring, director of software development programs, "no single operating system can cover them all." DOS and OS/2 are highly tuned for Intel processors, he says, while AIX couples tightly with the RS/6000. But IBM also sees the need for a portable, microkernel-based system, and it will begin to beta-test one later this year.

The forthcoming Workplace OS, built on a Mach 3.0 derivative, sounds a lot like NT. It will integrate multiple personalities—at least DOS, 16-bit Windows, OS/2, and AIX—under a future version of the Workplace Shell. The System Object Model, which

is the innovative object technology that powers the extensible Workplace Shell, will support distributed objects that communicate using TCP/IP sockets or DCE RPCs. Meanwhile, IBM continues to imNT'S ARCHITECTS SPEAK

Dave Thompson and Lou Perazzoli are key architects of Windows NT: They're the development managers for networking and the base system, respectively. Both had been working with DEC's VMS operating system prior to moving to Microsoft. Perazzoli, in fact, was part of the VMS development team headed by David Cutler, who is now NT's chief architect at Microsoft. BYTE's West Coast bureau chief Andy Reinhardt interviewed them for this article.

BYTE: I'm interested in the notion that you were able to look back at the history of midrange and large systems and select which operating-system features to migrate down.

PERAZZOLI: In fact we did that. We looked at the Unix standards and some of the things people did on mainframes with databases. We had done a lot of this at DEC, because at DEC we were designing a new operating system and we knew what limitations they had with VMS and what limitations they had in their Unix operating systems. We gained a whole lot of knowledge in what people wanted.



Lou Perazzoli

We have had an interesting opportunity to do things from the ground up, to write everything from scratch. We got to take code from current projects at Microsoft when we felt it was a good idea, or we could rewrite stuff when we thought that was a good idea.

BYTE: Did you have a sense when you started on this project that you were working on a historic operating system?

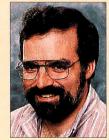
PERAZZOLI: One of the things we wanted to do was bring a high-end operating system to PCs. We thought this would go over really big, because we saw demand for it. We saw the downsizing trend happening, and we saw that the minicomputer would be replaced by PCs. It seemed to us this was the logical thing. Plus client/server was just starting to become viable; a lot of the groundwork had been laid, and people were now thinking about client/server as a model for running their business. So what we wanted to do was design something that was robust and had the features people wanted and

had client/server capabilities.

THOMPSON: I think my perspective may be a little different than Lou's because I came from the outside. My background was really more VMS-oriented than Unix or even PC, and it was clear to me that the PC needed a high-end, robust operating system. It was clear to me that if anybody was to supply that, Microsoft was in the best position. So I certainly sensed the potential from the very beginning.

BYTE: Is NT, as it stands today, relatively Cairoready? Is it architected in a way that makes the transition to a more object-oriented model fairly easy?

PERAZZOLI: Yes. In fact, there's a group here at Microsoft doing the development work, and essentially all they're doing is adding an object-oriented file system. NT already has four file systems [FAT, NTFS, HPFS, and CD-ROM], so adding another layered file system is not a hard thing to do. Most of the other things in Cairo are user-mode—for example, OLE 2.0 enhancements that they're making to applications.



Dave Thompson

BYTE: What's next for you guys?

THOMPSON: In the case of networking, there is a never-ending series of requests for connectivity on the system. There are a number of major ways in which systems are connected, and clearly one of the things

we need to do is expand our support for them. So I think on the networking side our work is pretty much cut out for us.

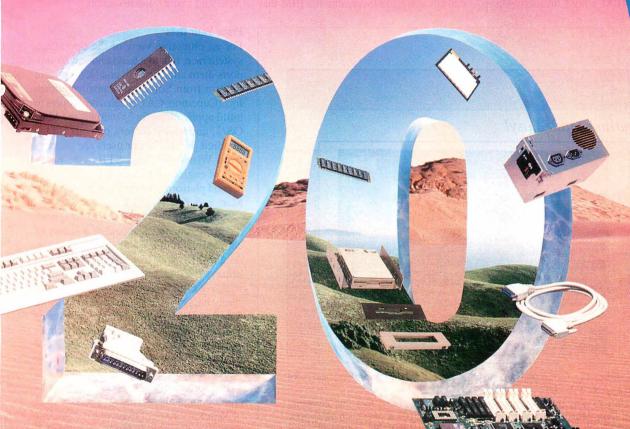
prove OS/2. Version 2.1, which is likely to ship before NT does, adds 32-bit graphics, badly needed video and CD-ROM drivers, and snappy Windows 3.1 support.

The dilemma for IBM is that main-

stream Presentation Manager applications that exploit OS/2's advanced features remain scarce. As a result, users tend to evaluate OS/2 as a platform for running DOS and Windows software. Unfortunately,

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Cover Story

Windows is a rapidly moving target. Because OS/2 2.1 doesn't support Windows VxDs (virtual device drivers), it won't be able to run Win32s applications. In theory, the Workplace OS could grow a Win32 personality, enabling it to run such programs in much the same way as NT does. Soyring hints that that may be the "fallback plan," but he maintains that "we won't encourage the development of Win32 software."

Although IBM's hold on the desktop

market is shaky, says Anders Vinberg, senior vice president of development with Computer Associates (Islandia, NY), Microsoft's grasp of corporate information services is even weaker. "People in the PC industry have holes in their perspective when it comes to CICS [Customer Information Control System] and transaction processing," he says.

However, OS/2's role as the glue between PCs and mainframes remains a crucial advantage. In this realm, it's IBM that looks like the innovator. Microsoft is taking a conventional approach, bundling a DLC (Data Link Control) protocol and a simple 3270 emulator with NT and separately offering SNA (Systems Network Architecture) and NetView services. IBM, already on top of these things, is raising the stakes by readying a DCE product suite for OS/2. More complete than NT's DCE offering, it will enable distributed transaction processing that harnesses OS/2, AIX, and mainframe resources.

Place Your Bets

For an objective view of the operatingsystem race, talk to a tool vendor who supports them all. The Universal Component System from Software Transformations, Inc. (Cupertino, CA), enables developers to build applications for Windows, the Mac, OS/2, and many flavors of Unix. "One hundred percent of our users are interested in Windows," says STI's vice president of engineering Doug Donzelli. "For a second platform, the choices are Unix, the Mac, and, finally, OS/2."

Almost no one can afford to ignore the power and mass appeal of a family of compatible Windows operating systems. As a result, many fear that Microsoft will achieve the kind of control that IBM once wielded. Others argue that while that will surely happen, it won't be such a bad thing for users. IBM's iron rule, after all, gave us a reliable infrastructure for banks, airline-reservation systems, and other essentials of modern life. Maybe we need that kind of standard again, and maybe Windows is it.

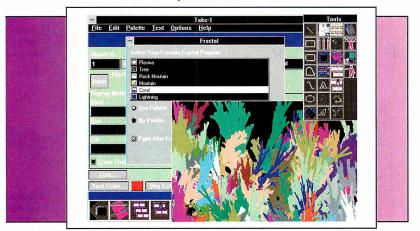
But fortunately or unfortunately, things aren't going to be so simple. The ascension of Windows has got everyone's competitive juices flowing. Portable, microkernel-based operating systems are all the rage, and while Windows NT is running at the head of the pack, it's not as far out in front as Microsoft would like you to believe. NetWare, OS/2, Solaris, NextStep, and the Mac are all emigrating to new hardware platforms and influencing Windows as much as it influences them. The "Windows everywhere" game holds much profit for developers and users, but it won't be the only game in town.

Editor's note: BYTE news editors Ed Perratore, Patrick Waurzyniak, and Dave Andrews, senior news editor Tom R. Halfhill, West Coast bureau chief Andy Reinhardt, and executive editor Rich Malloy also contributed to this article.

Jon Udell is a BYTE senior technical editor at large. You can reach him on BIX as "judell."

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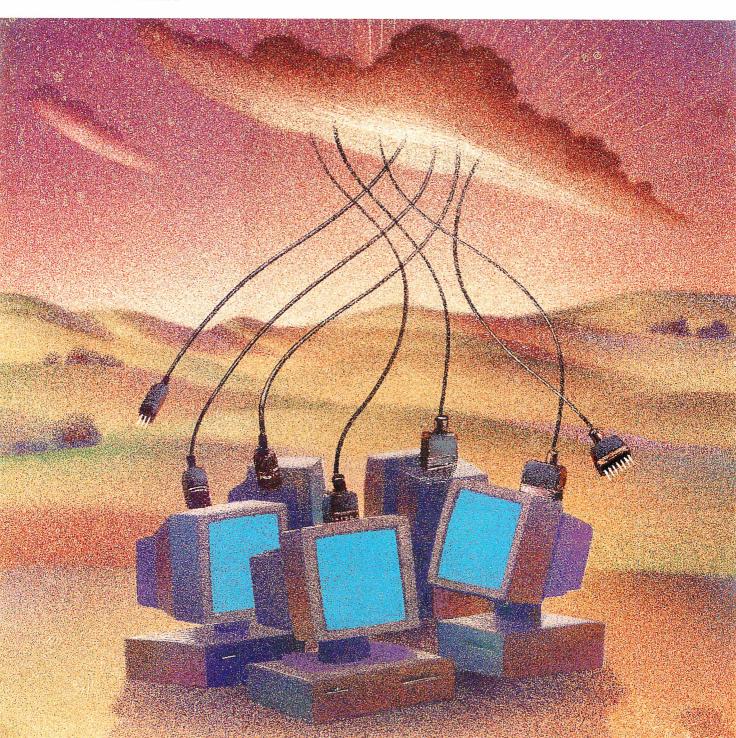


State of the Art

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arly in February, an old Honeywell mainframe rolled out of the Burlington Coat Factory's (Burlington, NJ) door, ending an era. Burlington, a retail outlet chain, would never see mainframe-based computing again. From then on, it would rely on client/server systems.

The U.S. House of Representatives also uses client/server technology, but it has no intention of scrapping its mainframe. Jim Daley, the database administrator for House Information Systems, describes his IBM ES/9000 as "solid as a rock." The House's client/server system functions as a front end to the ES/9000, which serves as a large database repository.

Burlington and the House of Representatives are typical of the early adopters of client/server computing. Every day they learn a little more about how to safely and efficiently move huge blocks of data off the big iron and onto networks of small, powerful computers.

If you move to client/server computing, it will change forever the way your enterprise accesses, distributes, and uses data. With this approach, data is no longer under the tutelage of the MIS department; it is readily available to you through your network. Consequently, you don't have to wait for the MIS staff to run your report. You can grab the data yourself and run it through a spreadsheet from your desktop using the brand of computer and the software tools that you're most comfortable with and that get the job done your way.

But getting client/server computing to work isn't all that easy. For example, it's up to you to find or develop print managers, console monitors, and other maintenance tools that came standard with mainframes. Your programming staffs, accustomed to writing large COBOL programs, may initially be mystified by Windows programming. And because client/server systems are complexes of hardware

and software from different manufacturers, finding and squashing bugs can be a nightmare.

Still, these headaches pale when you consider client/server computing's potential to revolutionize your enterprise. Not

only is data more available to you, but it's available through a system that can grow and change with you as your needs evolve. Further, because client/server systems are open and modular, you can tailor your system for your own particular applications, picking and choosing the most cost-effective hardware and software components for your tasks.

Specializing Platforms

A lot of companies make the move to client/server computing to cut costs. Burlington, for instance, replaced its mainframe, a machine with 4 or 5 MIPS of processing power, with a battery of six series 2000/750 Sequent computers, with a total of 1500 MIPS, and with Sun Microsystems ELC or SLC machines, the aggregate pow-

er of which Burlington can't even calculate. Each Burlington retail store now has a Sun computer with a SPARC processor, a 200-MB hard disk, and 16 MB of memory, "all for \$3995 [each] in quantity," says Mike Prince, Burlington's director of information services. "[Client/server is] overwhelmingly more cost effective."

But what may best define client/server computing, says J. Neil Weintraut, a senior technology analyst at the investment banking concern of Hambrecht & Quist (San Francisco, CA), is that it lets you pick and choose among platforms. "Anyone looking for *the* client or server is missing

the point of client/server," he says, "which is the ability to easily and rapidly customize relatively low-cost platforms for specific applications."

Because of the ability to specialize your platforms, you can get exactly the type of

What's in a Name?

workstation attached

to a network that you

use to access network

Client

A computer or

resources.

Server

A machine that

furnishes clients with

such things as huge

or connections to a

be mainframes.

network. Servers can

minicomputers, large

workstations, or LAN

one server can supply

devices. More than

services to clients.

disk drives, databases,

software you need to satisfy your requirements. For example, Burlington's Prince plans to choose between Solaris from SunSoft (Mountain View, CA) and Windows NT from Microsoft (Redmond, WA) based on performance (see "Windows Windows Everywhere?" on page 72). Daley at the House of Representatives sees products such as 4th Dimension from Acius (Cupertino, CA), a Macintosh software development tool, as "more contemporary" tools that let him deliver "more sophisticated" applications to end users.

Further, analyst Weintraut sees client/server technology becoming more versatile in the future. He envisions a new breed of "tactical" client/server applications, which he describes as applications that you

can dynamically modify to meet rapidly changing business situations. "Previously, changes would queue up for months or years in the MIS backlog," he says, "precluding any consideration of modifying applications in a pedestrian manner."

Enterprise Changes

Client/server architecture gives you as many access points to your data as you have workstations on your network. It also lets you bring to your enterprise more tools to manipulate data.

At Burlington, Prince says that this ability has changed the way people can work

Client/Server Frees Data

Client/server computing gives enterprise-wide access to data96



The Many Flavors of SQL



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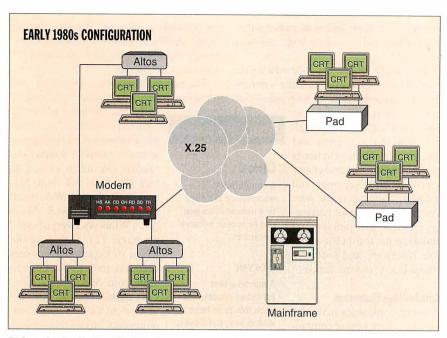


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State of the Art Client/Server Frees Data



Before the Burlington Coat Factory switched to client/server computing, store transactions were typed into a small, multiuser Altos. Transactions were sent via modem to an X.25 network and then to the mainframe at headquarters. Dumb terminals connected to network pads enabled data queries.

with data. Users no longer have to ask for MIS reports, because client/server computing empowers them to access Oracle databases at will. Users can feed information from the databases into spreadsheets or word processors on their desktop systems, seamlessly integrating the remote data with local tools. They couldn't do this on a mainframe, which limited access to computing resources. "People were discouraged from using [the computer]," he says. "Now they are encouraged to use it."

Burlington now runs its entire operation—190 retail stores, distribution centers, and headquarters—off its client/server system. The system handles everything from conveyor-belt scanners that generate database transactions to graphical workstations on which decision-makers enter queries.

In a typical Burlington retail store, the cash registers are NCR 7052s, which are DOS-based machines using the PC Network File Standard for network file services. The cash registers are connected by an Ethernet LAN to the main store processor, a Sun ELC or Classic. The Sun system acts as a file server for the registers and as a communications gateway to the central host computers.

Burlington stores communicate with various hosts on a network across a small satellite unit known as a VSAT (very small aperture satellite terminal) link via TCP/IP through X.25 protocols. From there, data

moves to several destinations, such as a gateway to VISA/MasterCard for creditcard transactions.

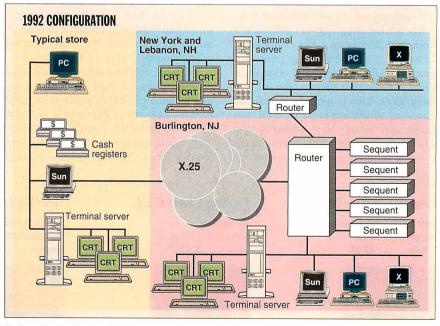
Store transactions pass over the satellite link and through front-end processing that switches them from a batch paradigm to transactions that can be stored in and processed by Oracle databases residing on several Sequent computers at the Burlington headquarters. A Tuxedo on-line transaction-processing system from Unix System Laboratories (Summit, NJ) is used to coordinate data updates. Tuxedo uses the cooperative resources of the network by concurrently running processes on several machines. Previously, transactional processing occurred on a mainframe in a time-sharing setup. An added benefit of spreading transactional processes across the network is that work no longer comes to a screeching halt when part of the network goes off-line.

Wide-Open Growth Potential

The client/server concept grew out of the competitive world of open systems. "When people say client/server now, you can almost substitute the phrase *open systems*," says Roger Sippl, a founder of database vendor Informix (Menlo Park, CA). "Open systems gave entrepreneurs the opening to solve particular problems, which benefits the users."

Client/server's openness means that you can choose from various vendors' products. "The flexibility it [gives us] is pretty much endless," says Frank Pellegrino, associate director of computer services for the Public Broadcasting Service (Alexandria, VA).

PBS's client/server system comprises a database from Ingres (Alameda, CA)



Today, Burlington's client/server system links all of its stores and distribution centers to headquarters. Store transactions enter network-ready cash registers linked to Sun computers, which also serve as communications gateways. Transactions are routed to a series of Sequent computers for processing. Terminal servers enable data entry and queries from workstations.



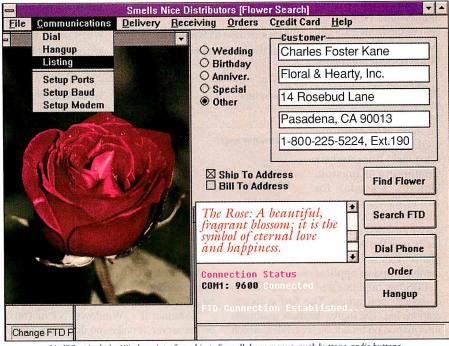
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State of the Art Client/Server Frees Data

connected over an Ethernet backbone network to VAX and Mac clients. PBS has begun moving the Ingres database from the VAX to HP9000 machines. Meanwhile, two VAX-based databases—Datatrieve and VAX DBMS—remain in use.

On the client side, PBS still uses character-based applications. Ninety percent of the front ends still run on the VAX with character-cell interfaces.

The Mac clients are used mainly for database queries, but PBS plans to deploy more features on them. The Macs use GQL (Graphical Query Language) from Andyne Computing (Kingston, Ontario, Canada) for writing database queries. PBS is still looking for easy-to-use tools that will let it use the Mac as a platform for full-function

database-update applications.

PBS has implemented two client/server—based applications. The first is its operations log. The Ingres database maintains information on broadcast schedules, which are automatically fed via satellite to PBS affiliates. The database also holds data used by automated broadcast switching equipment. In the second application, the database stores data about PBS programs, such as content, broadcast history, and right-to-broadcast information.

Previously, PBS employees requested this sort of information from a department that handled program data analysis, says Pellegrino. Now the client/server system, coupled with the Mac's ease of use, empowers people to do their own Ingres inquiries, and the data-analysis department is free to perform its other duties.

Adapts to Needs

Pellegrino's users want and can use the latest technology. "They are used to the mouse," he says. "They are used to point-and-click." Client/server computing gives Pellegrino the ability to equip one group of clients with

Client/Server Advantages

FEATURE	BENEFIT
Networked webs of small, powerful machines	If one machine goes down, your business stays up.
Computer arrays with thousands of MIPS;	The system provides the power to get things done
clients' aggregate MIPS beyond calculation	without monopolizing resources. End users are empowered to work locally.
Some workstations are as powerful as	By giving you more power for less money, the system
mainframes but cost one-tenth less	offers you the flexibility to make other purchases or
	to increase your profits.
Open systems	You can pick and choose hardware, software,
	and services from various vendors.
Systems grow easily	It's easy to modernize your system as your
	needs change.
Individual client operating	You can mix and match computer platforms
environments	to suit the needs of individual departments
	and users.

a Macintosh GUI while preserving the rigor and security of a centralized Ingres database for the computer services department.

"Whether it's [Windows] NT or Unix on the server, it makes no difference to the user," says Bob Epstein, founder of the database manufacturer Sybase (Emeryville, CA). "On the desktop, there is no such thing as one environment. A user can choose the Mac, Windows, or Presentation Manager."

had to redo the client side," says Daley. "But there was no change to the server side."

This modularity allows the system to expand to meet your growing needs. "You can grow by adding capacity to the servers or by adding more servers to the network," says Burlington's Prince. "You can add more clients. You can segment the net-

Thus, as new tools

become available, you

can change your client

software without dis-

turbing your server.

The House of Repre-

sentatives built its

clients using Sybase

APT, an applications

development environ-

ment on Unix, and

SuperCard, a scripting

language from Silicon

Beach Software (San

Diego, CA) on the

Mac. Unix and Mac

computers served as

front ends to the data-

base. Later, the House

of Representatives de-

cided to switch to

JAM, a VT-100 em-

ulator from JYACC

(New York, NY), and

Acius' 4th Dimension

development tool. "We

There's no upward limit to the scalability."
As new computing platforms emerge, you can evaluate new environments and system components in a modular fashion.

work if [it] starts to become a bottleneck.

For example, Burlington is debating future server platforms. For Intel architectures, it's looking at Windows NT, SunSoft's Solaris, and Next Computer's NextStep. Prince says that he believes in Unix, which will probably remain his choice for large database servers. Some consultants who focus on LANs, however, find difficulties with Unix databases (see the text box "Unix Database Servers Are Not for Everyone" on page 102).

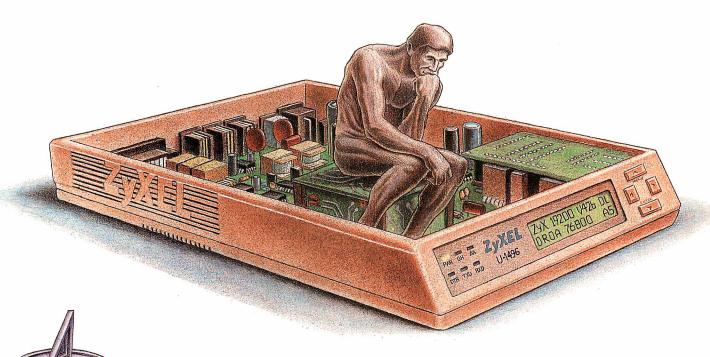
Client/Server Headaches

DOWNSIDE	WHAT IT MEANS FOR YOU
Maintenance nightmares	Parts don't always work together. There are several possible culprits when something goes wrong.
Support tools lacking	With the client/server architecture, you locate or build support tools yourself.
Retraining required	The software development philosophy for the Mac or Windows is different from that for COBOL or C.

Downsizing Downsides

Although PBS's Pellegrino enjoys the benefits of client/server computing, he still has to deal with its downside. For instance, Pellegrino had a hard time finding a bug in a

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Unix Database Servers Are Not for Everyone

PAULINA BORSOOK

any companies are satisfied with the results of implementing Unix database servers on a network, but some industry consultants strongly advise against considering this option. Robert Bolt, president of Database Server Systems (South San Francisco, CA), questions whether Unix's vaunted performance advantage is true for many configurations. It has been demonstrated by vendors, notes Bolt, that "a dual-processor Unix box running SCO Unix will not outperform a single processor box running Novell's Net-Ware"

Bolt has implemented client/server databases on more than three dozen different configurations. On LANs, Net-Ware database implementations "run circles around equivalent Unix boxes," he says. "A symmetric multiprocessor SCO Unix box is slower than or on par with NetWare," in Bolt's experience. A NetWare version of a database, he

points out, has been streamlined to maximize I/O. It doesn't have the graphics, user shells, preemptive multitasking, or scheduling that slow down Unix versions.

Other industry experts believe that maintaining and troubleshooting LANbased Unix database servers is too timeconsuming. Michael Booth, database consultant with 4GL (fourth-generation language) vendor Cognos (Burlington, MA), says that when Unix database servers are installed on LANs, system managers must decide whether or not they want to take on the added responsibilities of making GUIs, networks, servers, relational databases, applications tools, and various front- and back-end machines work together. "Users may be screaming for GUIs," says Booth, "but the increase in support costs may counterbalance any hardware savings."

Because client/server systems are commonly built with components from many vendors, havoc can ensue when you try to update a piece of hardware or software. For example, if you upgrade your software, "you're forced to synchronize releases of many operating systems across dozens of vendors," says Richard Finkelstein, president of Performance Computing (Chicago, IL), a consulting firm that specializes in database issues. "Any error can proliferate problems throughout your network."

So what's the bottom line? Bolt argues that you should watch out for technical overkill. If you've exceeded the capacity of your LAN and need to go from 30 to 50 users, he believes that you won't need a Unix box; a 50-MHz 486 will suffice. But if you must accommodate 500 users, Unix is a more resonable choice, he says.

If you are set on installing a Unix server, Finkelstein suggests working toward a homogeneous environment. That way if a problem pops up, it's easier to pinpoint where the responsibility lies.

Paulina Borsook is a freelance writer based in San Francisco, California. You can contact her on BIX c/o "editors" or on the Internet at loris@well.sf.ca.us.

GQL query. "Not only did it blow up my software," says Pellegrino, "but it blew up my hardware."

His query tried to multiply a character value, but none of the four pieces of software involved in the process noticed that he had formulated an invalid query. "You never know if it's something behind the scenes with SequeLink [client/server middleware] and the server," he says, "or something that's happening with the GQL." Often, it's not a fundamental bug in any one product, but a failure of the parts to agree on a division of labor.

Jim Daley at the House of Representatives considers the IBM ES/9000 he runs to be an excellent machine, and he knows exactly how to keep it running. But when there's a problem in his client/server system, there is a long list of things he has to check. "If you're sitting at a Mac, [a database query] goes from there to the Sybase database on Unix. From there, it could go to an IBM RS/6000, which then runs it up to [the] mainframe. The mainframe turns

around and sends it all back through. It's gone through several different products that [I] haven't even mentioned. [They all] come from several different vendors. Then again, it may be a hardware problem."

This typifies what might be the biggest challenge to successful client/server computing: You have to put together a complex system of hardware and software from multiple vendors. And when snarls develop, *you* have to determine which piece caused the problem. For many, this can be a rude awakening. "You no longer have one dominant vendor holding your hand," says Sippl. "IBM is not there saying, 'Don't worry." Just as personal computer users learned to get out their screwdrivers and plug in components, so, too, must client/server network managers learn how all the pieces fit together.

Mainframes came with prosaic but necessary support tools (e.g., printer managers, console and security monitors, and database tuning tools), but with client/server systems, you must hunt for the tools.

The early client/server users, says Burlington's Prince, "had to invent things themselves to do the basic functions that in a mainframe environment you would just procure from a vendor."

Another problem is that client/server systems require about one maintenance person per 50 workstations. "The labor required to keep the system operational must be reduced by a factor of 10," says Sybase's Epstein. Telephone companies are his model of excellence. "How many people does it take to keep a phone system operational? One for every 500 phones? One for every 1000?"

Client Conundrums

GUIs, and the Windows environment in particular, pose support problems, says Epstein. You can manage many more Mac clients than Windows clients because Macs are highly standardized, he says. Windows clients don't have the built-in consistency of configuration from one desktop to the next that Mac clients have.

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Unix Database Implementation Tips

Separate protocol stacks. If you are



using Windows, separate LAN Manager TCP/IP applications from those using FTP software or PC Network File Standard TCP/IP implementations.

Don't introduce new applications until you have

stabilized your hardware, software, and networking.



Link client/server applications



only to other client/server applications. Keep them separate from routine LAN services, such as printing and file-sharing.

The cornucopia of client platforms available to you also means that you'll have to maintain several versions of the front-end software. The House of Representatives, for example, maintains clients with three separate development tools: 4th Dimension, JAM, and Advanced Revelation from Revelation Technologies (Stamford, CT). Although it's working on a Windows client, the House of Representatives will not consider any tool that requires a separate code base for Windows. It's only looking at tools that allow conversions from existing client systems. "As far as Windows tools go," says Daley, "we're only looking at ports. We have enough clients.'

But your biggest obstacle in bringing up a client/server system is that you must relearn and retrain. Client/server computing is relatively new, and its development tools are different from those that large enterprises are accustomed to. Many corporate developers have been writing big, batch-oriented COBOL programs or interactive, character-based C programs.

In moving to graphical systems like the Mac or Windows, programmers' problems are not so much technical as they are philo-

sophical, says Pellegrino of PBS. His team had to learn how Mac programs are supposed to look, feel, and operate. "We were C programmers on dumb terminals," says Pellegrino, and not familiar with GUI programming. But it could have been worse, he says: "We could have been a COBOL shop."

Such concerns may be an indication that client/server computing has left its pioneering phase and is in an early stage of maturity. Sybase's Epstein notes that prospective customers now evaluate products with questions about system management, not with a feature list in hand. Thus, you can expect vendors to respond to market demands by offering maintenance and development tools.

Tools Trickle In

Early on, database companies neglected client/server software development tools, but they are working to fill the void now. In March, Oracle (Redwood Shores, CA) announced its Cooperative Development Environment, a set of applications development tools—portable among Unix, Windows, and Mac systems—that provides integrated development from design to maintenance.

Notably, Sybase and Oracle, known primarily as manufacturers of database engines, report that a growing portion of their revenues comes from development tools, support, and consulting. Sybase claims that 30 percent of its revenues comes from applications tools, and Oracle reports that more than half its revenue growth in 1992 came not from selling servers but from selling system integration services.

Independent vendors are jumping on the bandwagon and creating applications for the client/server architecture. For example, Sippl left Informix and has helped found Proactive Software (Mountain View, CA), which provides customer-support packages that can be customized and are designed to run on a variety of client and server platforms. Another new company, PeopleSoft (Walnut Creek, CA), offers financial and human resources software for Windows-based clients attached to several database servers. And Frank Dodge, of the McCormack and Dodge mainframe software firm, has formed the Dodge Group (Waltham, MA) to develop software for the client/server architecture.

Still, there is a need for everyday system management tools. PBS, for example, is looking for a good network monitor. And the House of Representatives wants what Daley calls an end-to-end debugging tool—something that could trace a problem through a maze of products on various platforms.

Despite the need for such system-management tools, it's unlikely that you'll see them soon, because all the client/server vendors would have to agree on an interface standard. Burlington's Prince is so adamant about the need for management tools that he is part of an association called MOSES (Massive Open Systems Environment Standards), a user-manufacturer community working to arrive at interoperation standards for systems tools (see the text box "MOSES To Set Standards" on page 104).

The desired utility programs are crucial to the long-term success of any client/server platform, according to analyst Weintraut. He believes that the lack of utility software for new platforms like Windows NT will slow their widespread adoption. Weintraut estimates that it takes about three years for such utility software to evolve in response to end-user needs.

Ever-Changing Future

Even as you learn to handle your client/ server system, new trends will change the

"You go to these client/server conferences, and the magnitude of the attendance surprises everyone. The people there are listening to anecdotes from customers who have deployed client/server systems successfully. It's as if they're listening to the pioneers who visited America and returned



to Europe to tell how great the new world was."

— J. Neil Weintraut, senior technology analyst at Hambrecht & Quist

State of the Art Client/Server Frees Data

computer industry's face. Because client/server computing is not an object but an architecture, each of its pieces—client, network, and server—will evolve in tandem with wider industry trends.

On the client side, the influence of multimedia could be the biggest factor for change. Gary Morgenthaler, a principal of the venture capital firm Morgenthaler Ventures (Menlo Park, CA) and a founder of Ingres, sees a "huge groundswell" coming from multimedia-capable desktop systems. He predicts that in five years a majority of personal computers will have digital audio and video capabilities.

With multimedia, a new paradigm for applications is possible. Sybase's Epstein envisions expansive customer-oriented applications, such as on-line catalog shopping, electronic banking, and stock trading. And PBS has "grand plans for multimedia," says Pellegrino. He envisions the PBS program database storing digitized film clips with descriptive alphanumeric data. Burlington also intends to deploy a range of multimedia applications in the future: videoconferencing, video and voice at-

tachments to mail-enabled applications, and pictures of merchandise and fabric swatches attached to spreadsheets and database tables.

Before these kinds of multimedia tools can come to client/server computing, changes in other server components are necessary. Networks, for example, will

have to offer wider bandwidth to support multimedia video, because at 60 12-KB frames per second, video hogs resources (see "Hitting Warp Speed for LANs," March BYTE).

Servers will have to be modified to handle multimedia objects, which have different structures than the alphanumeric, tabular data in SQL databases (see "The Many Flavors of SQL" on page 109). "Imagine multimedia-capable PCs by the millions connected to aging networks and SQL databases," says Morgenthaler. "People are going to be clamoring for new technologies to make it work."

Crossbreeding Databases

Servers may have to undergo dramatic changes. SQL databases, which are based on the relational database model, are optimized for alphanumeric data stored in 2-D tables. However, multimedia objects do not conform well to the model of the 2-D array. The question confronting the database industry becomes: Can a 20-year-old database model accommodate the new uses it will be asked to perform?

Morgenthaler, Sippl, and Larry Ellison, Oracle's president and CEO, say no. They foresee new databases that merge relational and object technologies. Sippl believes that more object orientation is inevitable because "people are beginning to store data that doesn't look anything like IBM punch cards." By the time this story goes to press, Morgenthaler Ventures hopes to announce its investment in a company creating just such a hybrid database.

Ellison says that within 24

You no longer have one dominant vendor holding

your hand. IBM is not there saying, 'Don't worry.'"

-Roger Sippl, founder of Informix

months Oracle will release a relational/object-oriented database that is used in conjunction with a language called SQL++. With extensions to standard SQL, the language will permit a user to evoke methods on objects. Because

some of the retrieval logic will reside in the database itself (i.e., in the methods) and not in the query statement, queries can be shorter and simpler, and that will be a boon to users.

Shorter and simpler queries are also foreseen by Setrag Khoshafian, the principal designer of Intelligent SQL and chief scientist and vice president of R&D at Portfolio Technologies (Newark, CA), a manufacturer of client/server products. Khoshafian sees trends toward object servers in which an object's data storage and database operations are encapsulated together at the point where object services are acquired through database operations. Khoshafian thus agrees that a database object will not be just a data type but a data type and its operations. When precompiled operations such as queries are stored with data, says Khoshafian, end users will spend less time writing queries.

Several benefits of hybrid relational and object-oriented databases are foreseen by Ellison, Morgenthaler, and Sippl. For one thing, your applications interface will be simplified. To get an invoice, for example, you would send a brief message to your database in place of a long SQL query. Another benefit would be that the message/result paradigm of the object model would reduce network traffic.

Hybrid databases could also integrate all the types of data that people want to store: text, images, voice, and video (see "Relating to Objects," December 1992 BYTE). On this point, Sybase's Epstein is not so sure. He thinks that tables, which are transactional data, should be kept in separate repositories from applications objects, which are not transactional and do not often change. But if people are going to use multimedia, notes Khoshafian, "they will want and need to insert and delete multimedia data, [as well as] perform some modifications of the data. Therefore, it will be desirable to have the updates of the multimedia data under transaction control." continued

MOSES To Set Standards



MOSES (Massive Open Systems Environment Standards) association is a loose alliance of client/server users and manufacturers. Members of MOSES seek to pool their knowledge

to create client/server management standards. Some of the items on its agenda include creating interoperation standards for systems tools and identifying policy procedures and internal practices that facilitate mission-critical client/server-based operations. "We're trying to put our heads together to come up with solutions to the problems we're all facing," says Mike Prince, director of information services for the Burlington Coat Factory (Burlington, NJ).

MOSES intends to produce white papers on such issues as how a system should behave, how to best archive data, and how to maintain client/server system security. Client/server users will be able to use the information in these white papers as a measure to compare against prospective approaches to these issues.

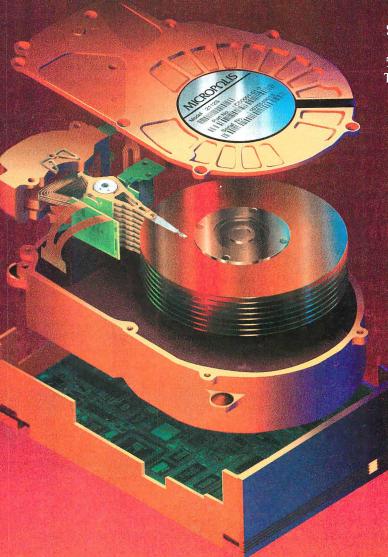
Among the members of MOSES are the Burlington Coat Factory, British Telecomm, Millipore, Oracle, Sequent Computer Systems, and US West Communications. To get on the MOSES distribution list, send E-mail via the Internet to inmoses@us.oracle.com.

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More To Come

Other trends are less controversial. For example, servers will become more intelligent. Ellison expects servers to hold both data and applications logic. Epstein sees clients and servers storing business rules, which will determine the integrity of transactions.

Servers also must be modified for the mobile user (see the text box "Serving Mobile Clients" on the right). Ellison and Morgenthaler imagine servers that download programs on demand to the mobile user, who then uploads the resulting data. Epstein foresees "dynamically partitioned systems" in which you download data that you can change and send back to the server. It will be the server's job to resynchronize the database.

Location transparency is also a feature that you'll find in future fixed-site client/server systems, according to Khoshafian. He points out that as global networks evolve, client/server systems will have the capacity to converse with one another regardless of their physical location. The challenge, according to Khoshafian, will be to provide users with integrated access to the remote systems in a manner that meets users' needs. This, he says, will be accomplished through integrator objects that combine, filter, and integrate services from multiple objects.

Faster, More Robust

Even though many support tools are missing and components can fail to work in complete harmony with one another, client/server architecture is changing the way organizations work. It's opening up tremendous, enterprise-wide repositories of data, logic, and business objects while empowering users to take advantage of this data through tools tailored both for the job and the user.

As part of an economic trend variously called downsizing, rightsizing, resizing and reengineering, more and more companies are eyeing client/server architecture as their next logical step. Setting up a client/server system is no cakewalk. It's a time-consuming, difficult trek. But as Burlington's Prince points out, compared to what came before, client/server computing is "faster, more accurate, and more robust."

Ellen Ullman is a software engineer and consultant with Neologica (San Francisco, CA). She is also a BYTE consulting editor. You can reach her on BIX as "ullman" or on the Internet at ullman@bix.com.

Serving Mobile Clients

DANIEL MEZICK

ireless communications has the potential to expand client/server computing far beyond the limited range of your local Ethernet segment. With wireless communications, you'll be able to access and manipulate your databases and other resources on your client/server system in real time from such remote sites as your home, a customer's office, or a building site. But before you can achieve unfettered mobile connectivity, tomorrow's client applications, called *ultimate clients*, will have to interact with servers in dynamic new ways.

To a client/server application, a wireless connection should be indistinguishable from its hard-wired cousins. However, one of the fastest wireless communications setups, WaveLan from NCR (Dayton, OH), offers bandwidth that's only 20 percent of the specified 10-Mbps Ethernet maximum. Further, the maximum broadcast range of wireless client/ servers is a cramped 800 feet, restricting their use to small groups within an office or a small building. You are most likely to find wireless client/ server applications in ad hoc workgroups performing such tasks as managing a political campaign or producing a sporting event.

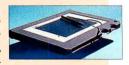
The mobile client may not be here yet, but mobile computing is (see "Wireless Mobile Communications," February BYTE). The only option available for dealing with roving users and mobile data is to place a subset of your server's database schema directly on your mobile device. This approach introduces redundancy and coherency problems, requiring reconciliation when the subset is reintegrated with the server database. Companies such as Norand (Cedar Rapids, IA) and Proxim (Mountain View, CA) hope to introduce solutions to some roving-client problems soon.

Another obstacle to using mobile

client/server applications is the capacity of the mobile devices. Large RDBMSes (relational database management systems) can eat up to a half megabyte of disk before you can even begin to store data. This is a burden for mobile computing devices, but small, fast, full-featured RDBMSes are emerging to address this need.

For example, Quadbase-SQL from Quadbase Systems (Sunnyvale, CA) is a fully relational database manager compliant with the ANSI-86 SQL standard. It consumes minimal disk space while providing support for data

import and export. Quadbase-SQL has such big iron features as outer join, correlated subque-



ries, and declarative referential integrity, allowing for complex database applications to be supported in a mobile computing application.

Finally comes the question of data security. Servers must be able to authenticate clients, ensure that messages are transmitted without error, and secure communications because wireless signals are easier to intercept than wired communications (see "Seeking Security," May BYTE). Securing wireless communications will involve encryption, although that incurs processing overhead.

Developments in cellular and radio communications are raising high expectations for wireless, ad hoc, ondemand data. Although the autonomous and mobile client has to wait for higher bandwidth communications, better software, and more security, vendors are beginning to meet the demand for wireless access to data. The truly mobile client and ultimate client applications are still two or three years away, but when they arrive, anywhere/anytime access to data will be just like another day at the office.

Daniel Mezick is the pen product manager for Linc Systems (Bloomfield, CT). You can contact him on BIX c/o "editors" or on the Internet at dmezick@world.std.com.

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State of the Art

THE MANY FLAVORS OF SQL

Everyone agrees that a SQL standard is essential for cross-platform client/server computing. but marketplace reality keeps getting in the way of good intentions

MARK CLARKSON



QL (Structured Query Language) has been *the* standard data description and access language for relational databases for almost a decade, making it a linchpin technology for client/server computing. The only problem with the SOL standard is that there are too many of them.

No fewer than eight efforts are underway to create a standard based on SQL. ANSI alone is responsible for three standards, either published or in progress. Other efforts involve industry consortia, such as SAG (the SQL Access Group) and X/Open, and companies such as IBM, Microsoft, and Borland. If you also consider that every database speaks its own SQL dialect and has its own set of unique extensions to the language, it's not surprising that client/server installations are the exception rather than the rule.

The lack of one widely accepted standard drives up the cost of databases and related tools and makes maintaining a client/server environment complex and difficult. "What is the difference between too many standards and no standards at all?" asks Anu Shukla, vice president of worldwide marketing for Amsterdambased Uniface. "Not much."

The Standards Soup

ANSI took the first crack at creating a SQL standard in 1989 (SQL'89) and followed up with a revision in October of last year (SQL'92). But because ANSI standards are vague about the details of their implementation, products that claim to be SQLcompliant often fail to work with one another. The proliferation of different SQL implementations by vendors led to the formation of SAG. A consortium of hundreds of companies in the database field, SAG was formed to generate SQL standards based on a subset of ANSI SQL'89 and to deal with issues of connectivity and programming interfaces for SQL clients and

State of the Art The Many Flavors of SQL

servers. In conjunction with the industry group X/Open, SAG is constructing a standard based on the current state of the art in client/server implementations.

Many major companies are not waiting for the efforts of standards-setting bodies to bear fruit but are launching their own attempts to create de facto standards. Last year, SAG member Microsoft introduced ODBC (Open Database Connectivity), a SQL database API standard based in part on a draft of the SAG standard. Borland, also a member of SAG, is readying its own SQL API standard, called IDAPI (Integrated Database Application Programming Interface), which is based on the SAG version. Both companies are lining up support for their standards.

In addition, ANSI is working on its next-generation SQL standard, called SQL3. Not expected until the latter part of the decade, SQL3 will add structure, branching, flow control, error handling, and object-oriented capabilities to an already groaning SQL standard.

Finally, IBM is developing its own standard for database access, DRDA (Distributed Relational Database Access), which

includes yet another version of SQL. Given the variety of SQL standards, says Judith Hurwitz, president of the Hurwitz Consulting Group (Newton, MA), "It's quite understandable if you're getting confused."

The Importance of Standards

The reasons for the proliferation of SQL standards are many. One is that standards are designed to serve only as guides. This leaves a lot of room for interpretation as a vendor takes a language specification and implements it in software. Like two house builders working from the same blueprint, says Hurwitz, "different people can interpret a specification differently."

This assumes a vendor is trying to conform to a standard. More often than not, vendors are trying to do much more. "The problem is that each vendor has probably made excellent, but different, decisions about how to extend the SQL standard," says Malcolm Colton, director of product marketing at database vendor Sybase.

Writing standards-compliant code means that a developer is using three- to fiveyear-old technology, says Colton. If you want the benefits of the latest technology,

> you can't conform to standards. "For example," says Colton, "we have had flow-control statements, stored procedures, and triggers in Sybase's SQL dialect since 1987. SQL'92 doesn't have those features. That's the type of thing you find in the SQL3 standard." In the absence of an acceptable standard, database vendors have invented their own.

A Question of APIs

Even if the market's competitive pressures forever deter the universal adoption of a single SQL standard, database and tool vendors are looking at other ways of making life easier in the client/server environment. "I do not see the SQL language standards as too important," says Ron Wolf, product marketing director for SQL

database vendor Gupta (Menlo Park, CA). "The next step down—the programming interface—is where significant things are happening. Those standards are quite a bit more useful."

The programming interface—referred to as the API or the CLI (call-level interface)—lets programs communicate with a database using function calls instead of SQL statements. Where SQL standards address data access and manipulation, API standards deal largely with connectivity issues: connecting the client to the database and exchanging SQL messages and data.

A common API for SQL would make it less expensive for developers to support several different databases, making their tools more affordable. However, a common API may prove elusive, given market realities. Microsoft and Borland are pushing their own API standards on SAG, and the consortium has yet to weigh in with its finished standard.

Going Nonstandard

ODBC, IDAPI, and SAG's APIs are based on a common subset of the ANSI standard. That, says Uniface's Shukla, is taking the lowest-common-denominator approach, which "doesn't exploit the features of a database, other than perhaps Microsoft's or Borland's own."

Database tool vendors, who must deal with a host of different databases and exploit the individual capabilities of each to the fullest, resort to intelligent drivers. These drivers sit on top of a data source—usually, but not always, a relational database—and intercept incoming messages from clients.

The driver then translates the messages into a SQL statement or a series of API calls that is tailored to a database. Instead of talking directly to the database, the client tools speak to the drivers. With the proper driver, any application can function as a SQL server and be accessed by the same tools used with relational databases. Such drivers can fine-tune transactions, maximizing performance based on the SQL dialect or API library involved.

For example, says Shukla, Uniface has an intelligent driver that exploits all the features of each of the 27 databases it supports. As SQL standards grow larger and more complex, she says, "the standards bodies are taking longer to ratify them." In fact, the glacial pace of ANSI is largely responsible for the involvement of industry consortia like SAG and X/Open in the SQL standards business.

continued

What SQL Is



Relational databases store data in tables—rows and columns—not unlike spreadsheets. The SQL language includes commands to describe, create, and delete those tables, as well as to update the data within them. For example, to re-

trieve the names of inexpensive writers from a database, you might use the following statement:

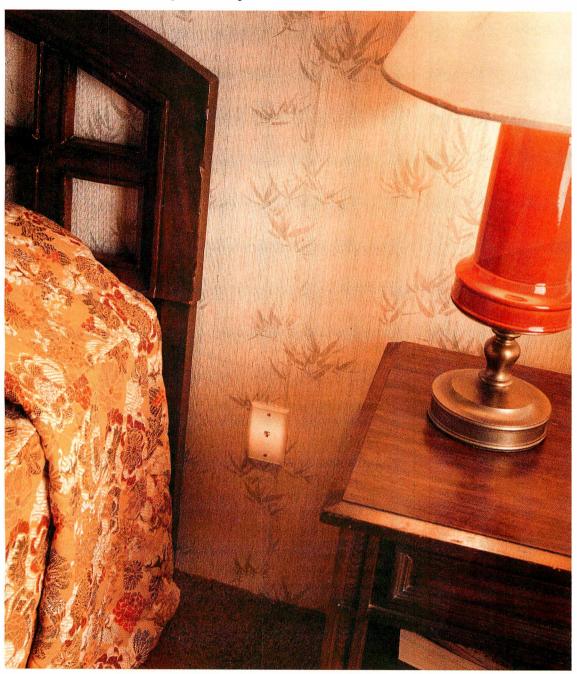
SELECT Writer FROM Writer_database WHERE Pay_per_word < .05

You can also embed SQL statements in other languages, such as C and COBOL.

Using SQL, a client computer can access data anywhere on a network. SQL commands don't refer to data's location; data can be moved from platform to platform without affecting the application code.

Theoretically, SQL lets database vendors create products compatible with databases and tools from other vendors. Almost all tools in the client/server arena expect to communicate with the server database using SQL commands. These tools can access other data sources, too, if the sources present a SQL-compatible interface. Practically, however, the many different flavors of SQL make integrating different database tools difficult at best.

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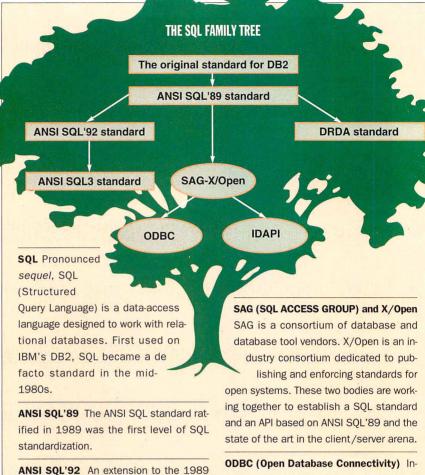
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State of the Art The Many Flavors of SQL



ODBC (Open Database Connectivity) Introduced in 1992 by Microsoft, ODBC is based on early work of SAG and X/Open. It defines an API for database access.

IDAPI (Integrated Database Application Programming Interface) IDAPI is based on the work of SAG and X/Open and reflects Borland's attempt to define a SQL API.

DRDA (Distributed Relational Database Access) IBM's evolving standard for database access across all IBM platforms includes another take on SQL.

Next-Generation Databases

What does the future hold for SQL? Yogesh Gupta, a senior vice president at Computer Associates (Islandia, NY), thinks it might hold echoes of the past. He points out that when relational databases came to prominence, there was debate about what the query language of choice should be. Then IBM came out with DB2 using SQL, and SQL became the de facto standard. "The same thing can happen with ODBC," says Gupta. "Microsoft is in a position to

standard, SQL'92 will become an impor-

tant standard in the next few years, as

database vendors and database toolmak-

ANSI SQL3 An effort to expand the lan-

guage substantially, SQL3 will provide more

structure and standards for accessing object-oriented databases. Look for it by mid-

ers move to comply with it.

decade, at the earliest.

initiate it, and the time is right." Of course, that can also be said about SAG or Borland.

Although the world of SQL is in turmoil, it's unlikely that SQL will be supplanted anytime soon. "Standards take such a long time," says consultant Hurwitz. "You don't want to just trash all that work and move on to something new."

Mark Clarkson is a freelance technology writer living in Wichita, Kansas. You can reach him on BIX c/o "editors."

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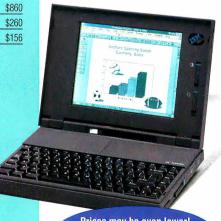
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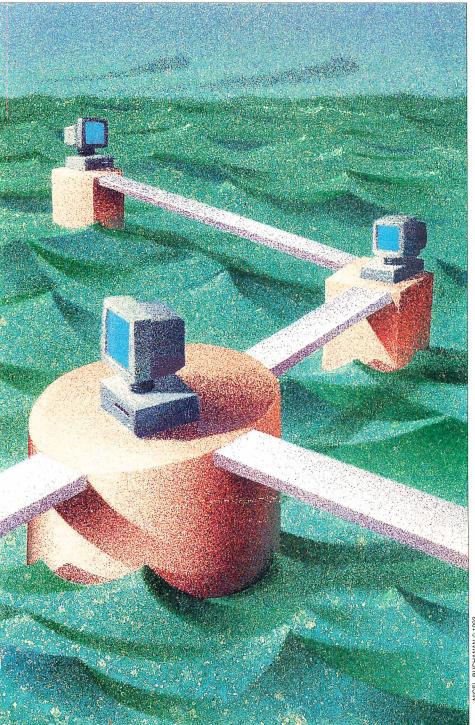
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State of the Art

MAKE WAY FOR DATA

Middleware, such as RPCs and message-passing systems, helps data move smoothly through client/server networks. Soon these capabilities will become a part of your operating system.

PAUL KORZENIOWSKI



he term *middleware* is becoming quite fashionable, and many suppliers are bandying it about. But what is it, and how does it work? It's difficult to define, because thorny matters relating to building distributed applications (e.g., having an application function consistently while running on different operating systems) don't fit neatly under a single term. And further blurring middleware's identity is its transparent nature. "Users want transparent access to information, so the goal of middleware is to make itself invisible," states Martin Goetz, president of Martin Goetz Associates, a consulting firm based in Teaneck, New Jersey.

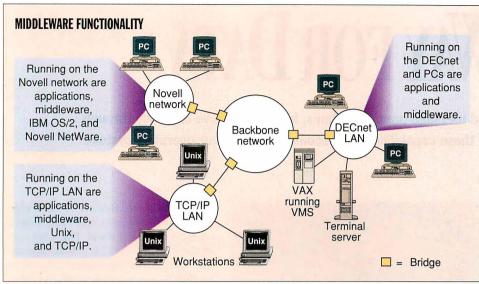
Middleware is a breed of client/server software that helps move data between applications running on your computer and your network. The software gives your programming team standard APIs that save development time, because the programmers don't have to modify applications to accommodate network protocols. With middleware, your programming team wastes less time trying to make an application work with your network's protocols or operating system and is free to spend more time fine-tuning your application.

For example, IBM's Logical Unit 6.2 network protocol has 32 verbs (e.g., SEND and RECEIVE). Some of them have more than 100 parameters. Your programmers have to tinker with more than 1400 error conditions to get everything to work. But middleware, such as Message Express from Horizon Strategies (Needham, MA), can reduce the number of verbs to five and the parameters to about a dozen.

OLTP (on-line transaction processing) monitors, which speed the exchange of data in various transactions (e.g., booking airline reservations) between databases and data sources, often provide middleware features. And many database companies, such as Gupta Technologies (Menlo Park, CA),

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Middleware uses RPCs or message-passing techniques to overcome network and operating-system incompatibilities. A backbone network links DECnet, Novell, and TCP/IP networks. Middleware, running on each network component, ensures that all network users have transparent access to applications and resources on any of the three networks.

build middleware components into their product lines so that each product can interact seamlessly with its siblings. But neither OLTP monitors nor databases with rudimentary middleware functionality are designed solely as stand-alone products that move data smoothly across a network.

Today, two primary types of middleware are available: RPCs (remote procedure calls) and message-passing systems. But tomorrow, distinct middleware products could vanish, because their main components are becoming integral parts of operating systems, much as TCP/IP has become a part of many Unix implementations.

RPCs Deployed Widely

RPCs are the best-known and most widely deployed class of middleware, according to Max Dolgicer, a director at Tucker Network Technologies (South Norwalk, CT), a consulting firm. An RPC functions like a programming call, completing a single processing chore in a series of steps undertaken by a software program. For instance, a programming call may gather a set of customer records. That step would be just one of many functions an application would have to complete to generate a company's monthly invoices.

Traditionally, applications and their programming calls ran on one computer. But with client/server applications, your records may not be located on the computer running the application. Consequently, you need a mechanism to travel through a network, find the data, and bring it back to your application. RPCs perform these chores in a manner that's transparent to end users, making it seem as if the data is stored locally.

RPCs first emerged in the Unix environment for Sun Microsystems and Hewlett-Packard computers, later branching out to desktop and larger computers. For example, five years ago, Novell (Provo,

UT) began reselling RPC Tool from Netwise (Boulder, CO) and announced that it planned to incorporate the package in future versions of NetWare. RPC Tool supports a number of operating systems, including MS-DOS, OS/2, and Windows, as well as such network protocols as AppleTalk, DECnet, NetBIOS, and TCP/IP.

HP's RPC, NCS (Network Computing System), received a big boost three years ago when the vendor consor-

tium OSF (Open Software Foundation, Cambridge, MA) selected it as the basis for its DCE (Distributed Computing Environment) standards. DCE is a set of standards designed to help users and software vendors create client/server applications.

OSF claims that more than 100 vendors are building DCE products, including DEC (Maynard, MA) and HP, although no such products have appeared on the market yet. Much of the activity is focused on Unix-based systems, where the vendors are building DCE products to run on the OSF/1 and Unix System V release 4.0 operating systems.

Gradient Technologies (Hudson, MA) is leading the charge to

bring DCE to PC users. Formed three years ago by former Prime Computer employees, Gradient built PC-DCE to run under Windows. It claims that more than a dozen suppliers, including HP and IBM, plan to incorporate PC-DCE software into their product lines. PC-DCE lets you build applications on your PC that will work with versions of the application running on other types of systems.

Passing Messages

Although not as widely deployed as RPCs, message-passing systems are gaining acceptance rapidly. "Both message-passing systems and RPCs will be adopted," notes Tucker Network Technologies' Dolgicer, "but a message-passing system offers more flexibility."

Both types of middleware were built on antithetical foundations, says Dolgicer, and each possesses pluses and minuses. RPCs were designed to connect two computers using synchronous connections. As a result, the software produces inefficient processing. For example, if there is not a clear line between two computers, the computer running the application sits and waits for a line to open. The upside is higher data integrity. Because of the tight connection between the two computers, it's likely that both will work with up-to-date information. High data integrity is important with mission-critical applications, such as electronic funds transfers.

Message-passing systems, on the other hand, are based on a flexible, store-andforward methodology that is common with E-mail systems (see "Smarter E-Mail Is Coming," March BYTE). A message may

Remote Procedure Calls

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Cons

- is difficult to use with many servers
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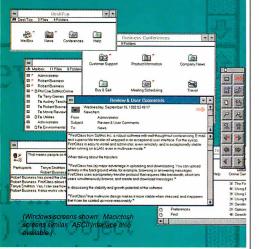
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State of the Art Make Way for Data

have to pass through computer after computer to reach its destination. Rather than wait for each computer to be free, a message-passing system moves the message forward whenever the next resource needed to get it closer to the destination (e.g., a port or process) becomes available. Using this system, your computers never sit idly waiting to establish network connections. The downside is unreliability. For instance, a message can get struck halfway to its destination, and neither side would know there was a problem.

The XIPC (XInterProcess Communications) message-passing system from Momentum Software (Englewood, NJ) is used by American Airlines to speed up client/

server applications development. "We needed software that could pull information from a variety of DBMSes," says Patrick O'Leary, a consultant who works at American Airlines. "We thought about developing our own but determined that the Momentum software had most of the features that we needed."

American Airlines used XIPC to build a cargo-system application for its employees and a sec-

ond application, which O'Leary declined to identify, for an American Airlines customer. O'Leary says that XIPC cut development time by two-thirds, because it was easy to program. The company is considering using the software for additional applications.

Management Technologies, Inc. (New York, NY), a designer of financial applications, uses XIPC to simplify porting its software. "Our customers operate a wide range of computers, so we needed tools that operated in many environments," explained John Brann, MTI's vice president of research.

MTI selected XIPC over competing RPCs and distributed OLTP monitors because the Momentum message-passing system seemed to offer the most flexibility and was the most mature product, says Brann. MTI built its application in nine months, about half the time it would normally devote to such a project. Further, Brann reports that a beta version of the application has been running smoothly at customer sites.

Disappearing Future

Message-Passing Systems

Pros

Cons

provides flexible

programming model

· has small user base

lacks set standards

capabilities

· offers no instant-update

· uses resources efficiently

· works well with networks

It's likely that middleware will slowly disappear as its functionality becomes a base operating-system component. This incorporation may already be under way. For example, the Windows NT operating system will incorporate RPCs (see "Windows Windows Everywhere?" on page 72). And while the future of RPCs may look bright, that of message-passing systems is less sunny, because the technology is immature and competing against an established RPC base. One indication of the status of message-passing systems is that OSF has no plans to establish a message-passing mechanism at this time.

As middleware is integrated into client/

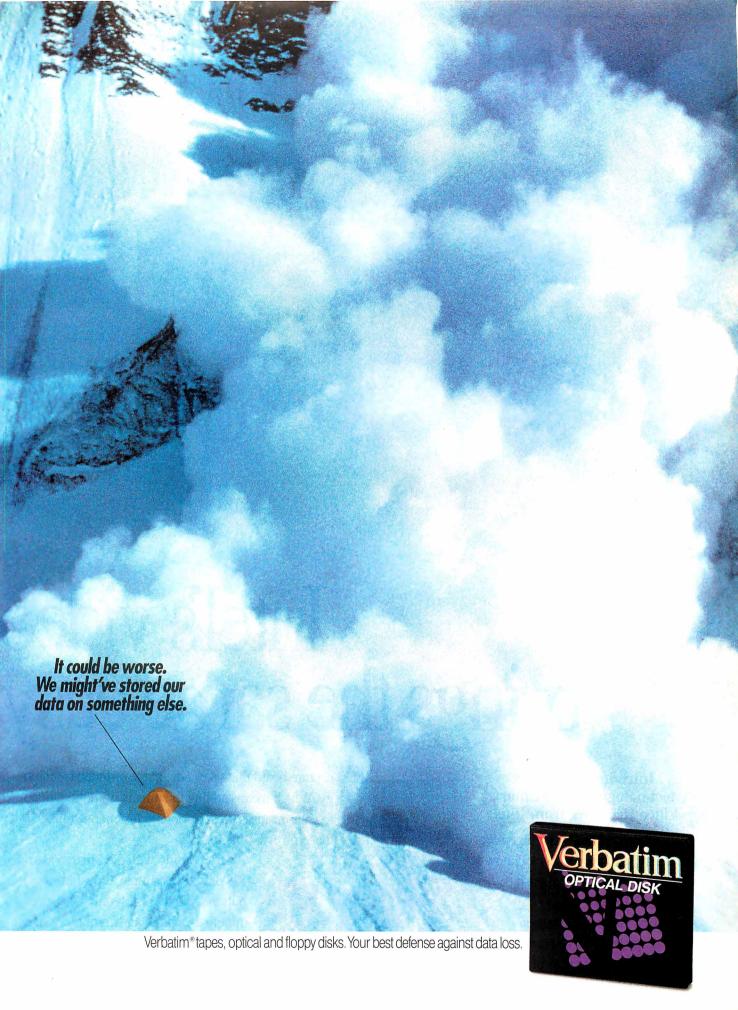
server operating-system functions, you can expect to see new genres of middleware emerge in response to wider industry trends. For example, it's likely that software will evolve to facilitate the use of multimedia applications on different platforms. "Historically, vendors have attempted to differentiate their products with high-level software," notes Michael Matthews, marketing manager for distributed-computing programs at Hewlett-Packard

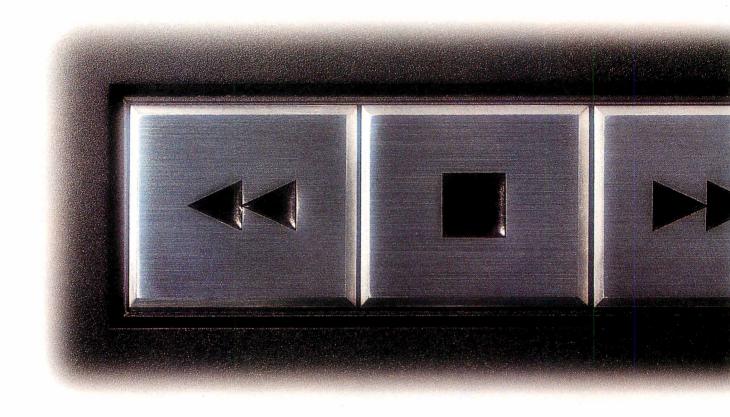
(Cupertino, CA). "I expect a similar transformation will occur once there is a large base of middleware."

Even though Matthews and other observers expect another three to five years to pass before that transformation happens, evidence of middleware's growing influence can be seen now. For example, OSF's DCE comes with such features as naming-service functions and security safeguards, but it also comes with an RPC. ToolTalk from SunSoft (Mountain View, CA), a set of applications development tools, comes with CASE tools and built-in messaging functions.

Larry Russell, SunSoft's ToolTalk product manager, expects the number of middleware products to expand significantly during the next few years. "Users want universal plug-and-play capabilities with their applications," he says. Middleware helps them get it. ■

Paul Korzeniowski is a freelance writer based in Malden, Massachusetts. You can contact him on BIX c/o "editors."





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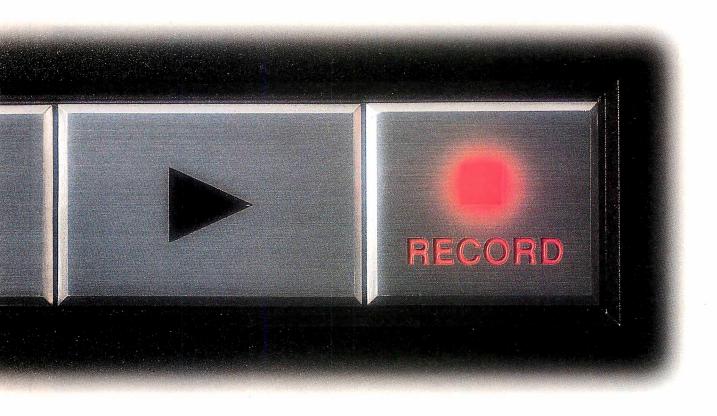
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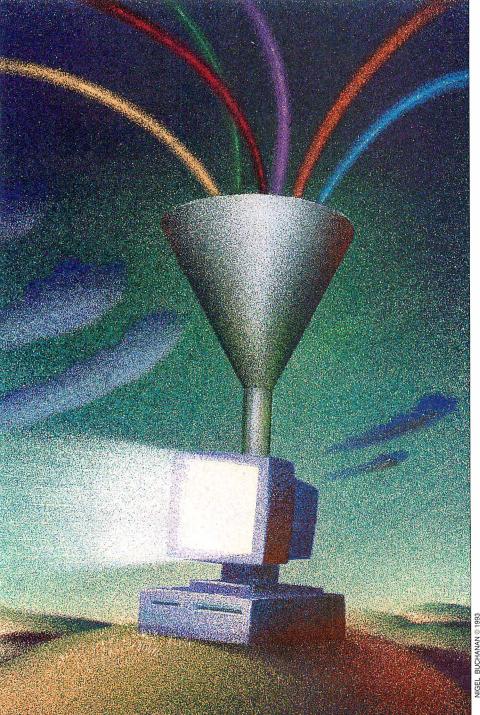
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EISES MINE YOUR DATA

Executive information systems and client/server computing help you understand your data better

RANDALL D. CRONK



lient/server computing is transforming EIS (executive information system) software. With an EIS, you can pull together, view, analyze, and report on data that's in assorted formats such as spreadsheets or mainframe databases. Client/server computing has changed where people find information and how they understand that data once they acquire it.

The alliance between EISes and client/ server computing means that, in theory, anyone in your organization can become a knowledge worker (i.e., someone who can acquire, analyze, investigate, manipulate, observe, and study data). "In the past," says Tom Wood, an analyst at the consulting firm Business Research Group (Newton, MA), "most EISes were mainframe-based and hierarchical. The data you received was structured and not easily manipulated—not exactly what knowledge workers needed to do their job correctly. The client/server shift solves this problem perfectly."

Because of a client/server's ability to interconnect, today's EIS generation gathers data not only from mainframes but from sources such as minicomputers, LAN servers, and networked PCs. "In client/ server computing, the PC does what it does best—manipulates data—while the data itself can stay on the mainframe," says Howard Dresner, an analyst with the Gartner Group (Stamford, CT).

EISes give you powerful analytical tools that help you pinpoint meaningful relationships and trends in your data throughout your distributed databases. Graphics features let you depict data in charts and graphs that easily communicate its significance to your colleagues. Using statistical-analysis tools and data definitions in your database, an EIS can even suggest what data you should present and how to

Still, EISes have problems. For example, they don't always give you easy access to

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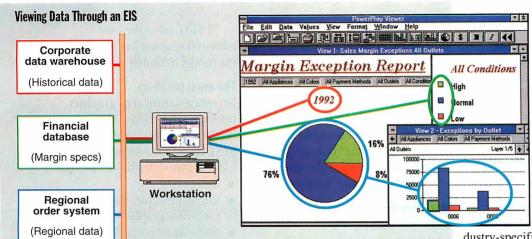
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State of the Art EISes Mine Your Data



Cognos's PowerPlay, running on a client/server system, has been fed data from three databases. This data has been used to develop a pie chart on last year's sales conditions. The bar graph shows how the same data can be manipulated to produce a what-if scenario, enabling you to explore and develop new strategies. (Photo courtesy of Cognos)

data, despite what some vendors claim. But the biggest problem, according to Dresner, is on the data preparation side: Where is the data? How do you clean it up, make sense of it, and relate it to other information? "The person responsible for implementing the EIS product may know that the relationships are there [in the database]," says Dresner, "but may not be able to find them or present them through an application to users in a timely fashion so they can act on it."

Once you find the data, you must deliver it—not an easy step with today's patchwork of network protocols, database managers, operating systems, and windowing environments (see "Client/Server Frees Data" on page 96).

Bridges to Data

Client/server computing is great in theory. Most database servers speak Novell's Net-Ware, TCP/IP, or both. Several of the popular database managers, such as Sybase and Oracle, allow you to access remote databases as if they were on your PC.

But in practice, real-time access to your production database isn't always as easy as clicking on a few icons. For example, when you first install your EIS, it might not be able to tell you whether the data you want is available. If it can, you might not be able to extract or manipulate the data unless you can apply your own expertise to your database's query language. Even if you can get your EIS to produce the data, the data may not be presented in a form that you or your applications can

read. For example, your EIS may be able to handle Lotus 1-2-3 or dBase, but your data may be formatted for an arcane main-

frame database manager.

When problems arise, they usually are not with your network-to-database connections. Rather, they occur because your EIS either can't read the format of the data itself or cannot cope with the schema used to organize the database. Further, some DBMSes are tied to industry-specific formats, such as the Apollo or Sabre airline reservation systems.

If you work with an in-

dustry-specific database, you might have to rely on yourself or a third party for a data provider to serve as a bridge between your EIS and data. EIS vendors cannot make bridges between their product and every database. For example, if you use PowerPlay from Cognos (Burlington, MA), you'd have to rely on Showcase Vista from Rochester Software (Rochester, MN) to access your IBM AS/400-based

What business does sound have in a computer?

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21	Maintenance	= =	69.400	74,952	80.160	224,5
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23	Rent		188,440	203,515	219.796	611,7
24	Depreciation, Building	Mute	6,400	7.168	8.028	21,5
25	Insurance		12.670	13,684	14,779	41.1
26	Utilities		14.100	15,228	16,446	45.7
27	Total Operating Expen	ses	480,710	519,423	559,929	1,560,0
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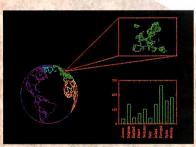
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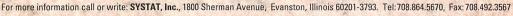
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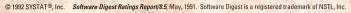
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State of the Art EISes Mine Your Data

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3000

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1987

(Source: International Data Corp.)

1989

EIS Site Installations Soar Worldwide

database, because Cognos doesn't make a data provider for it.

End-user experiences vary. For example, Gordon Seeler, a technician at Pruden-

tial Insurance (Newark, NJ), reports that Forest and Trees, a Windowsbased EIS from Channel Computing (Portsmouth, NH), comes with the bridges he needs. Seeler's job is to set up Forest and Trees throughout the company. Prudential's main database is IBM's DB2. Forest and Trees accesses DB2 via Microsoft's SQL Server, which allows a PC to

access DB2 data over a network (see "The Many Flavors of SQL" on page 109). The connection to the SQL Server is a data provider within Forest and Trees itself.

"I love it," says Seeler. "The product is easy to install. I just insert the first [of three] disks, go to Windows Program Manager, drop down the file menu, and select RUN. Forest and Trees prompts me for what data providers I want installed, and that's it."

Staging Strategies

Perhaps more typical are those client/server administrators who cannot—or do not want to—assign direct connections between end users and live databases. Instead, they opt to create an intermediate staging database. Charles Smith, general manager of a beer distributor in Kingston, Massachusetts, chose this option.

At the heart of Smith's problem is that the EIS he uses, Pilot Software's (Boston, MA) LightShip, cannot access the company's industry-specific DBMS, the VIP Beverage System from Vermont Information Processing (Colchester, VT). Smith's solution is to download VIP data from his IBM System/36 server to a standard dBase-type file running on a 486-based PC. His clients then access the data from their 386-based PCs running LightShip. LightShip uses a single data provider, called LightShip Lens, which is compatible with such widely used data formats as Microsoft's DDE.

Smith, whose background is in finance, set up his first EIS application for sales analysis in about two weeks. He doesn't consider this an unreasonable amount of time, especially in view of what the application does for him. For instance, Smith says that his LightShip application helps

maximize profits by letting him determine how many bottles of beer should be stocked at certain sales outlets. "This will let me bury my competition," says Smith.

Security and compatibility factors are among the reasons that Chemical Bank uses a data-staging strategy. Cort Jacobsen is a vice president at Chemical Bank's securities trading department. He uses dBase running on a pair of 486-based PCs as a staging database for two reasons. One is to keep clients from sending queries against the trading database, which could

slow down the database and result in a lag in the posting of stock market activity reports. The other reason is to overcome format incompatibilities between Light-Ship Lens running on client 486s and the database containing the bank's trading records, running under Microsoft's Fox-

1991

pro on 486-based servers.

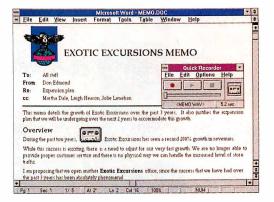
Although LightShip can access Foxpro data directly, it can't do so with Foxpro's memo fields. This complication makes historical-trend analysis impossibly long to accomplish, since LightShip cannot use Foxpro's data indexes for searches. Like Smith, Jacobsen doesn't consider these data-connection issues a serious obstacle. One reason for this is that, as with many large companies, Chemical Bank has an information systems infrastructure for which such workarounds are not difficult to implement.

The good news is that the need for these kinds of workarounds is vanishing rapidly as EIS vendors implement data providers for more and more databases. Channel Computing seems to have the longest list of databases for which data providers are available, although all EIS vendors continue to add to their own lists.

EIS Magic

According to Judith Hurwitz, president of Hurwitz Consulting (Newton, MA),

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What EISes Do for You

· create graphically rich

· find data in multiple

distributed sources

provide information at

• suggest pertinent data

and how to present it

• give you statistical-analysis

tools for summarizing and

or near real time

structuring data

between data

• help discover relationships

charts

customers are buying EISes today without the data providers they need, proving the perceived value of the genre. Sales fig-

ures buttress this assertion. Clare Gillan, director of information access for International Data Corp. (Framingham, MA), a marketresearch firm, reports that sales of PC-based EISes jumped from about \$5 million in 1985 to \$125 million last year. By 1996, IDC projects that sales will rocket up to \$329 million.

"Executive decision support used to mean back rooms filled with programmers, each one providing a 'view for hire,'" says Hurwitz. "By comparison, to-

day's EISes are not especially difficult to install or use, and [they] provide an enormous amount of leverage."

"The magic," says Hurwitz, "[is that an EIS] lets you see things you can't see just by looking at rows and columns." Indeed, some packages, such as IDIS: The Information Discovery System from IntelligenceWare, go so far as to suggest what trends and relationships you should be asking your database about.

To do this, IDIS scrutinizes your raw data and uses statistical analysis to generate rules about it. For example, while looking at a supermarket's national sales data, IDIS might generate a rule that says that if a supermarket is between 31,000 and 73,000 square feet in size and sells between 2500 and 3000 boxes of cereal weekly in February, then 92 percent of the time, it will sell between 4000 and 5000 cases of milk in July.

Cognos's PowerPlay also uses statistical analysis to automatically suggest how data should be summarized and structured. Its statistical-analysis capabilities let you determine, say, whether a particular sample of time-series data would be more meaningful to you if it were displayed as a monthly, year-to-year, or year-to-date sampling. You can also determine whether there is greater variability in your sales data if the data is displayed by product type, vendor, or geographic region.

Helps You Think

With its combined graphical interface and multidimensional-analysis capabilities, an EIS has the power to help guide you in your thought process. "Dimensionality is as key to the new EIS paradigm as client/server computing," says Douglas McCartney, Pilot Software's vice presi-

dent of marketing. "It gives you the ability to see the relationships in your data that are not obvious to you."

One dimension of a sales transaction, for example, is what sale was made when. Other dimensions are year-to-date sales, this year versus last year, first quarter versus second quarter, and so on. However, it is likely that none of these dimensions is called out explicitly in your database. An EIS can bring the relationships

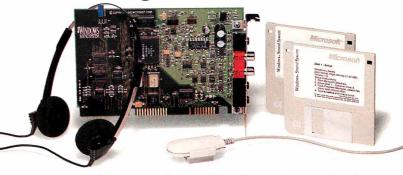
of these dimensions to the surface for your investigation and analysis.

That's precisely how Jerry Reilly, a data administrator at Amitech (Sellerville, PA), a gauge maker, uses PowerPlay. In what he describes as a "breakthrough application," Reilly analyzes product-delivery performance in many different ways. For example, he can analyze performance for the company as a whole; for any market group, customer, salesperson, or distributor; and for any time period or product type. In addition, Reilly can view the analysis in dollars, quantity, or number of orders. He can place months as rows and view performance as a trend line. He can also analyze performance at either of Amitech's manufacturing plants or for both simultaneously.

"In the old days," states Reilly, "when I printed a report, the next thing that would happen would be people coming back and wanting it sorted in a million different ways. No longer." Reilly says his next PowerPlay application will "reengineer the business." It will give him gross margins for any customer, region, product, or item sold.

In addition, EISes let you use graphics to manipulate the data, not just present it. Virtually every desktop EIS offers a "drill-

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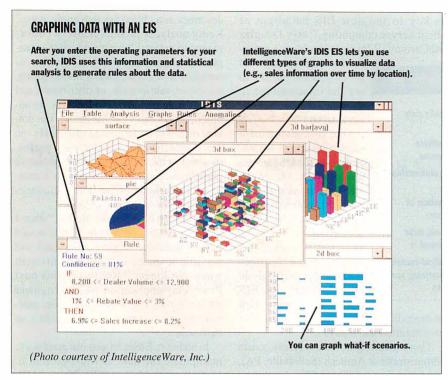
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State of the Art ElSes Mine Your Data



down" capability, for example. This means that you can click on a data item, say a pie slice representing New York state sales, and view the underlying statistics, such as a pie chart of all your New York distributors.

More recent capabilities allow you to set up virtual instrument-control panels for monitoring your business in real time.

SEARCHING WITH AN EIS

LightShip, for example, allows you to display a chart of statistics as a bar graph by clicking on that presentation in a style menu. You can then drag the bar graph next to the original chart and view both at the same time. Using a "view selector" window, you can size your graph and populate it with the names of some of the fields in the original chart (e.g., regions,

The lines connecting icons express the relationship among actions that comprise a sales transaction.

years, and products). By scrolling through this window and double-clicking on the desired view, alternative presentations of your company's sales performance are displayed, all in real time. You can even make the words in the main title change automatically according to the name of the view being displayed.

Increasingly, EIS makers are using hypertext to make data manipulation more powerful and intuitive. IntelligenceWare's Iconic Query, for example, lets you specify relationships between objects by drawing a line between them. This allows nonexperts to express relationships that may not have been previously defined in the database and thus are unavailable to Iconic Query. For example, drawing a line between a shipments icon and a customers icon expresses the notion that shipments are made to customers.

EIS Potential Grows

EIS vendors claim that their products empower you to find relationships and trends in your distributed data so that you can quickly adopt new business strategies; many EIS users agree. According to Charles Smith, "20 seconds is not long to wait for a [business] strategy."

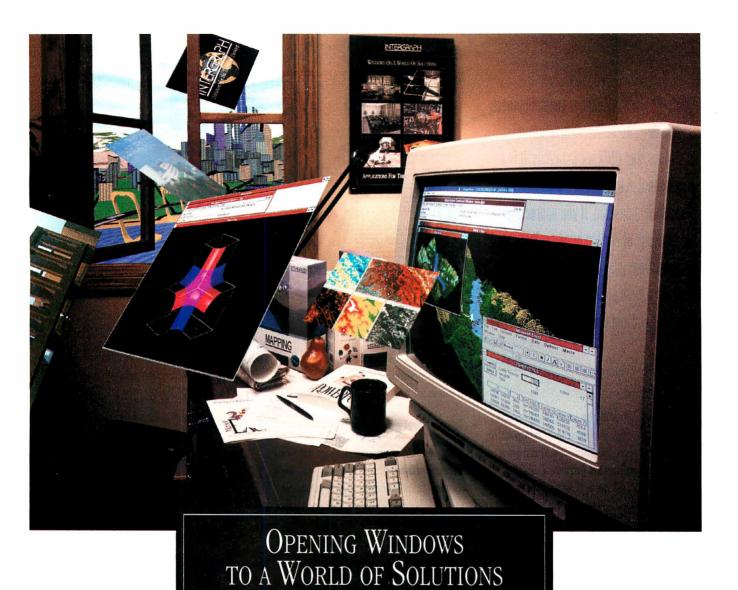
But, obviously, issues such as data staging and interchange need more attention and they're getting it. This attention is evident in the growing lists of databases and compatible data formats supported, the higher level of built-in statistical-analysis functions, and the hypertext features.

Still, the energy behind the acceleration of desktop EIS is the continuing expansion of client/server computing. According to analyst Wood at the Business Research Group, 51 percent of all personal computers are networked, and 49 percent of all networks are interconnected to another network. Furthermore, a recent Business Research Group survey of 500 companies found that two-thirds of the companies either have begun to implement a client/ server computing strategy or have one in place already.

According to Wood, the trend is undeniable. "In the past, the obstacle to EISes on the PC was the lack of a client/server infrastructure," he notes. "Now companies are installing [that] infrastructure." ■

IntelligenceWare's Iconic Query lets you search for a particular item, generate a graph, or create a report. Icanic Query Purchase HyperText Query 1 SELECT CUSTOMER NAME, CUSTOMER.NO Area legico PURCHASE_AMOUNT > 6,000 AND PURCHASE DATE > 1-12-1992 PO You define each icon before you begin a search. Iconic Ouery lets you select icons The parameters shown define the customer icon. that represent your databases. (Photo courtesy of IntelligenceWare, Inc.)

Randall D. Cronk of Boston, Massachusetts, is a marketing consultant for software companies and a freelance writer on computer-industry topics. He holds an MBA in marketing from Clark University (Worcester, MA). You can reach him on BIX c/o "editors."



In the world of Windows NT, Intergraph's applications bring a new level of power and sophistication to the technical desktop.

The computer graphics industry has made another leap forward. Under Microsoft's New Technology operating system, popular business programs and Intergraph's

"The Microsoft-Intergraph alliance provides a full range of technical applications, as well as a wealth of personal productivity tools — complete solutions for the technical desktop."

Paul Maritz, Microsoft Senior Vice President of Systems technical applications can run alongside each other on the same computer. The same friendly Windows environment appears throughout the applications — word processing, spreadsheets, architecture, civil engineering, mapping, and all the rest. CAD users can now spend time designing and drafting, not navigating through the operating system.



PCs, Macs, and UNIX workstations. It is a primary tool in Intergraph's solutions for the technical desktop. If you appreciate the economy of PCs but need sophisticated design power, take a look at MicroStation. It means a more productive, more profitable future for you and your company.

should give you the productivity edge you need to be competitive in today's business environment. You need a tool that streamlines the process of drafting,

"MicroStation includes a robust set of 3D capabilities and gives you a variety of ways to render models."

Infoworld

as well as a modeler that helps you create virtually any object — fast. You should be able to store design data in relational databases without programming. Your future depends on the ability to share data

with your design team and other operations. MicroStation software gives its users this level of proficiency. And keeps them in tune with the best in applications solutions.

Intergraph introduces
MicroStation Version 5.
It refines a product that is
considered the state of the art in
CAD graphical user interfaces
(GUI). In doing so it boosts CAD
to a higher level of usability.

MicroStation Version 5 brings renowned integration advantages to designers and

Request. For Proposal

Request. For Proposal

Request. For Proposal

Recursive and Proposal

Recursive

engineers who need to run in the Microsoft Windows

business environment — Windows, Windows for Workgroups, and Windows NT.

Software that puts you in charge.

Today, *user friendly* means more than easy—it means software that empowers you. You control MicroStation through a graphical command center featuring icon command buttons ... pull-down menus ... tear-away palettes ... multiple, resizable overlapping views. The display is sleek. With no perceptible repaint, Version 5's graphical user interface seems to float over your drafting and design area.

MicroStation runs as an extension of the way you work. Choose from unique *Workspaces* designed for your profession. They configure the graphical CAD desktop for you and manage the computing environment to your needs. Even discipline-specific drafting *styles* are provided. And it's all tailorable: Graphically build your own pull-down menus and palettes. Rearrange fields in dialog boxes. Disengage commands. You've got the power to create the interface that best meets the needs of the task at hand.

CAD software should accommodate the way you think, work, learn — even change your mind. You should be able to select a different dimensioning system right in the middle of a command. Or modify a shape and have

"MicroStation PC is an exceptionally usable, powerful package with such rare and exotic features as nonuniform rational B-splines."



February 23, 1993 ficroStation PC, 4.0.3

PC Magazine

MicroStation .

integrates with

Windows business

your favorite

applications.

all of the dimensions automatically change. Simple actions — like grabbing a line or object — should be so fast that they require no conscious effort. MicroStation performs functions like these as a matter of course. Other CAD software simply can't.



Store information in popular relational databases — without programming!

A powerhouse of features gives you the productivity edge!

MicroStation offers more functionality in one package than any other CAD software. New dimension-driven design options help you design intelligently using geometric and dimensional constraints. Apply variables to the constraints and save your design for reuse with different parameters when creating similar objects or parts. These and more new capabilities — like user-defined linestyles and associative patterning and hatching — provide the most complete drafting environment available.

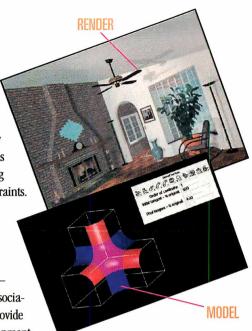
Powerful tools help you create freeform, mathematically precise surface models. Model virtually any object, no matter how complex. Perform trim, blend, fillet, and Boolean operations between surfaces. You've got the simplicity of solid modeling without the overhead.

Visualizing your designs is easy and cost-effective with MicroStation's new photorealistic rendering capabilities. Light sources, shadows, transparencies, depth cueing, anti-aliasing, and bump and pattern mapping help you market your designs. You can even create flythrough animations and play them onscreen for your clients. MicroStation is a powerhouse of features in one package.

The best tool for the '90s production environment.

Users value the way MicroStation performs in the production environment. On large projects, it's a clean-running, fast performer. One user said, "MicroStation is an all-encompassing system ... capable of covering all facets of project management, not just design and drafting."

MicroStation users enhance productivity through real-time data sharing. True file referencing allows each member of a workgroup to easily



and safely share files concurrently with others. It's peer-to-peer sharing of design information while everyone continues working — across multiple hardware platforms and networks.

Run MicroStation with other Windows applications. Cut and paste graphics in a Word oproposal. Link document text with your MicroStation design file. Drive MicroStation graphics with an Excel spreadsheet. Embed sounds and messages in your design file.

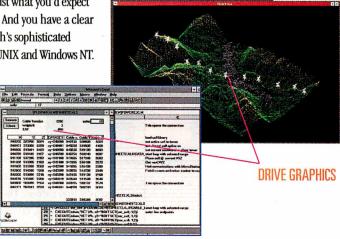
MicroStation

All in all, if you combine MicroStation's integration capabilities with Windows' data sharing capabilities, you've got just what you'd expect from a '90s CAD product. And you have a clear growth path to Intergraph's sophisticated application solutions for UNIX and Windows NT.

MicroStation Version 5 reads and writes to AutoCAD .dwg format.

"Compared to DataCAD, AutoCAD, and VersaCAD, MicroStation is much faster ..."







Beyond the immediate benefits, there are advantages that come

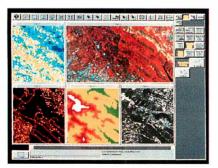
from Intergraph's years of experience. In some industries, 25 years is not much. In computer graphics, 25 years is the lifetime of the industry. For almost a quarter of a century, Intergraph has developed computer graphics systems — hardware, software, and support — for industries that rely heavily on maps, engineering drawings, and models to convey information.

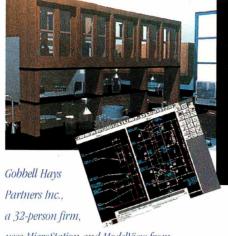
limb the Statue of Liberty, ride Swiss Rail through the Alps, use the 1993 Rand McNally Road Atlas, or take a break with the world's most popular soft drink. In these unexpected places — and hundreds of others —

you'll find the results of combining Intergraph's computer graphics experience with users' ingenuity.

With Intergraph's
MGE geographic information system,
California's Division
of Mines and Geology
will provide digital
maps to enable
Californians to determine if they live in
risky earthquake or

landslide zones.





uses MicroStation and ModelView from Intergraph to design laboratories for corporations and universities. Says firm president Ronald Gobbell, "Three-dimensional modeling shows the scientist exactly how his lab is going to look." With MicroStation, Gobbell Hays can customize and reuse cells with symbols of equipment, cabinets, and other basic lab features.

The Intergraph advantage.

The arrival of a powerful new Windows operating environment means that for the first time, hundreds of thousands of microCAD users will have access to the functionality and technical sophistication of Intergraph applications.

Long-term partnerships with customers worldwide.

Intergraph's reputation for top-notch customer service follows the company around the globe as international business steadily increases. Intergraph's extensive customer support network

continues to earn top ratings in customer satisfaction surveys. The most recent Daratech *Industry Update* quotes a wide range of Intergraph users range from small offices or departments to large multinational firms, and their projects run the gamut from single drawings to complex aircraft carriers.

Intergraph users satisfied with their systems. Intergraph's track record of technological stability and continuity is important:

"Intergraph has given me a competitive advantage for a number of years."

"No other vendor could have given us total binary file compatibility for all these years."

"I'm a firm believer that they have the best CAD product on the market."

Daratech Industry Update November 1992

Olé OLE

Integrate CAD processing with other Windows applications such as Word and Excel by taking advantage of complete support for Microsoft's Object Linking and Embedding (OLE) technology.

Linvatec Corporation uses the high-performance solid modeling technology in Intergraph's Engineering Modeling System (EMS) to design products for least invasive surgery. The process of identifying and developing new and innovative products is



fundamental for growth in
the health care industry, and
Linvatec credits
Intergraph systems
for providing
a strong
competitive edge.

Intergraph is the world's largest independent development site for Windows NT applications.

Low-cost suite of AEC applications

Feature-packed and available at a low cost, Intergraph's MasterWorks applications for architects and civil engineers bring a new level of power and value to the technical desktop. Intergraph brings to the Windows world functions formerly available only in high-end CAD systems. The MasterWorks series includes these applications:

RoadWorks — transportation engineering DesignWorks — architectural design CogoWorks — coordinate geometry FrameWorks — structural modeling SiteWorks — site design

Whatever your project, MasterWorks will empower you to master your design challenges.

Affordable, expandable geographic information systems (GIS)

With the Modular GIS Environment (MGE) solutions for the PC, Intergraph gives you the best of both worlds — the power of the world's leading GIS on the world's most popular computing platform. Using MGE PC solutions, you can build an integrated, powerful GIS without investing large amounts of time, money, or resources. Start with a single PC and add workstations and sophisticated software as your needs grow. Or expand your existing MGE network with cost-effective PC seats. MGE PC solutions include:

MGE PC-1 — database creation and project management
MGE Grid Analyst PC — spatial modeling and analysis
MapInfo for Windows — desktop thematic mapping
MGE Project Viewer — read-only database display and query

Technical leadership.

The list of disciplines addressed with Intergraph software is one of the longest in the industry — and continues to grow.

- Aeronautical charting Architecture
- Cartography Civil engineering Dispatch management Document management
- Electronics design Energy exploration
- · Environmental resource management
- Facilities management Geographic information systems Image processing
- Industrial design Manufacturing
- Mechanical engineering Photogrammetry
- Plant design
 Publishing
 Ship design
- Surveying Telecommunications Urban planning Utilities gas, electric, water

In 39 of the 50 departments of transportation in the United States, Intergraph applications for surveying, civil engineering, and GIS enable the DOTs to design and maintain the nation's transportation infrastructure.

New opportunities arise when you go with the CAD standard.

MicroStation can give you a foot in the door on major projects around the world. For example, the U.S. Army Corps of Engineers and their subcontractors use MicroStation-based applications. On the massive Hong Kong airport project, Intergraph has been named CAD supplier in the four contracts announced so far. Through numerous contractors and subcontractors, Intergraph applications will play a major role in designing and building the new airport and township, as well as the railway that connects them to Kowloon and Hong Kong.

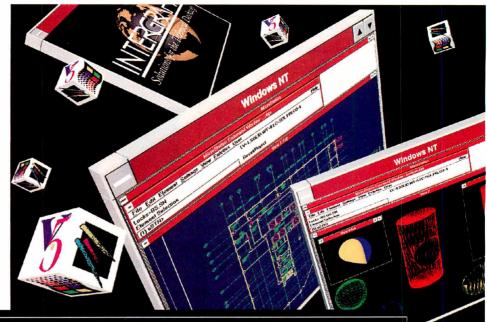
Designed for Windows NT — the new Technical Desktop Series workstations.

Intergraph has traditionally supplied complete software and hardware solutions. In keeping with this tradition, Intergraph offers its own systems designed for Windows NT. They're optimized for CAD immediately out of the box, with full networking capabilities built-in. So it's simply plug-and-play. And with an Intergraph workstation, display clarity, high resolution, and graphics performance make viewing your work a pleasure.

These fast, affordable systems are perfect for running the new technical applications from Intergraph, along with thousands of other applications that run under Windows. And workstations in the Technical Desktop Series are fully interoperable with other systems on your network.



Before you spend a dollar, look at the value of your investment. You can be highly productive with MicroStation's powerhouse of features for only \$3,790



CALL 800-345-4856 today for an Intergraph Solution Center reseller or sales representative in your area.

APPLICATIONS FOR WINDOWS NT

Innovative technology — once the domain of high-end systems — is now available on the technical desktop. For a more productive future, this is what you need . . .

Workgroup integration.

Intergraph pioneered reference files, the technology that enables each member of a workgroup to easily share designs with others. And, since .dwg files can also be referenced, you can work with AutoCAD-created data in MicroStation. In the Intergraph distributed computing environment, you share information, printers, plotters, and storage devices — and see dramatic savings in time and money.

Integrated applications.

Intergraph's integrated data management architecture provides access to technical information within applications and across disciplines. This means that Intergraph's applications can address an entire project workflow from end to end. Access to information across disciplines is made even easier by the fact that all applications feature the same easy-to-learn-and-use graphical user interface.

Smooth operation between operating systems.

Many of Intergraph's customers operate on networks that include a mixture of workstations and PCs, so interoperability is essential. Because Intergraph application file formats are common across hardware platforms, there are no problems of data incompatibility or translation, and sharing data is easy. Also, basic Windows NT includes all the tools needed for TCP/IP communication with our UNIX-based systems, so users can mix UNIX-based and Windows NT-based workstations in their networks and enjoy smooth interoperability.

Relational database support.

Intergraph data management tools feature built-in interfaces to Oracle, Informix, and other database management products. This support of leading databases in multiple environments enables you to create links to them without programming.

Growth path.

If you choose to upgrade your hardware or add other high-end technical applications, Intergraph gives you a growth path. You can upgrade your system and continue to share files.

Open systems and industry standards.

Your investment in hardware and software is protected by Intergraph's continuing support of major standards for computing, networking, drafting, and design.

Value-added services.

Intergraph also provides support in the form of project implementation, customization, systems integration, training, and worldwide service and maintenance.

Call 800-345-4856 for an Intergraph sales representative in your area.



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Apple's Midrange Mac a Heavy Hitter

The Centris 650 packs a wallop for just over \$3000

TOM THOMPSON

ntil early this year, the midrange Apple Macintosh was the Mac IIci, a 25-MHz 68030-based computer. Now, with its Centris line of Macs, Apple put this aging warhorse out to pasture. The 68040-based Centris line redefines the norm for midrange Mac performance. It also redefines the price of this performance: A three-slot, 25-MHz Centris 650 with 8 MB of RAM and an 80-MB hard drive costs \$3169, and you can get a 20-MHz Centris 610 configuration for as low as \$1969.

The Centris 650 redefines midrange-Mac performance by outrunning the Quadra 700 while maintaining a price close to those of high-end PC clones. Equipped with a doublespeed CD-ROM and a 25-MHz 68040 processor, the Centris 650 makes a solid multimedia platform. Here, the Centris 650 is quickly running Reactor's Spaceship Warlock interactive movie directly off CD-ROM.

CD-ROM Included

The Centris 650 looks just like a Mac IIvx, and in fact it uses the same chassis. My evaluation unit was packed with goodies: 8 MB of RAM, a 230-MB hard drive, built-in Ethernet, 1 MB of VRAM (video RAM), and a CD-ROM drive. The cost of such a system is \$3939. The 1 MB of VRAM gives the Centris 16-bit color capability on a 640- by 480-pixel screen, making it useful for most image editing and multimedia work.

When setting up the Centris, I couldn't locate the packet with the usual high-density floppy disks containing system software. I was looking in the wrong place, because CD-ROM-equipped Centris systems include system software on a CD platter. The Centris boots from this CD-ROM by default when it can't locate a bootable SCSI drive. You can also force the Centris to boot from the CD-ROM by holding down the Command-Option-Shift-Delete keys simultaneously as the computer starts. Either way, a CD-ROM boot lands you in the At Ease shell, a system shell that puts you a mouse-click away

from applications that format the hard drive, test its integrity, and install the operating system. Other utilities allow you to create high-density floppy disks loaded with system software. such as a bootable "crash floppy" that includes disk formatting and repair

applications. Storing crucial system software on a sturdy, read-only medium and providing ready access to it is one of Apple's better innovations.

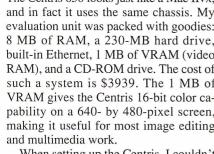
A CD-ROM-equipped Centris can handle a wide variety of media. Its AppleCD 300 CD-ROM supports CD-ROM XA (Extended Architecture), which lets it read multisession Kodak Photo CD format. A QuickTime compressor/decompressor provided with the system software lets graphics applications transparently read the images stored on Photo CDs. The AppleCD

> 300 is a double-speed drive, which means it delivers over 300 KBps, twice the transfer rate of earlier drives. I inserted Reactor's Spaceship Warlock interactive CD-ROM into the drive and launched the software. This software makes heavy use of graphics and sound and is sensi

tive to system throughput. On a Quadra 950 using a slower CD-ROM drive, I had to copy the files onto the hard drive to get acceptable performance. On the Centris 650, I ran the interactive movie straight off the CD-ROM with snappy response.

With the Centris's 68040 heart beating at 25 MHz, you would expect to get only Quadra-700-class performance. However, the BYTE application benchmarks show otherwise, with the Centris 650 running about 13 percent faster than the Quadra 700. This is a conservative estimate, since I had to disable the processor caches (which degrades performance) in order to run Word 4.0 in the word processing benchmarks. The combined effects of tightly integrated components (which reduces the clock cycles required to shuffle data about the system) and interleaved memory (which minimizes the clock cycles needed to access adjacent memory locations) result in a tremendous performance boost for the system.

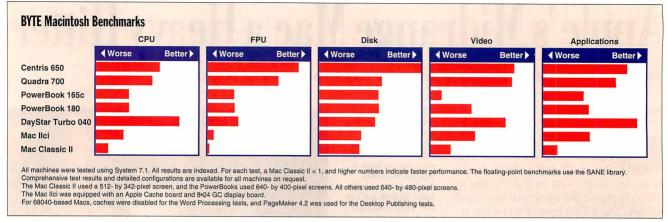
For those who bought a Mac IIvx and





If you're not quite ready to retire that Mac Ilci but want Quadra performance, there's DayStar Digital's Turbo 040 (\$1599). The Turbo 040 is a 33-MHz 68040 accelerator board. At boot time, the Turbo's faster 68040 processor outraces the Ilci's CPU and takes control of the system. The Turbo 040 has a plug-in socket for a FastCache (\$399), an expansion module with a 128-KB, 12-nanosecond SRAM (static RAM) cache. A Ilci equipped with a Turbo 040 and a FastCache performed better than a Quadra 950.

Reviews Apple's Heavy Hitter



BYTE's Macintosh application benchmarks pegged Centris 650 performance about 13 percent higher than the performance of a Quadra 700. The PowerBook 165c is about as fast as a PowerBook 180 on most tests, but it falls behind on benchmarks that depend on video speed.

are disappointed with its performance (it's actually slower than the older IIci), there's still hope. For \$1199, Apple offers a main logic board swap that upgrades the IIvx

to a Centris 650. Be aware that the Centris uses a new 72-pin RAM SIMM that is incompatible with the 30-pin SIMMs found in the IIvx and older Macs.

PORTABLE COLOR



The PowerBook 165c is more or less a Power-Book 180 under the hood: It contains the same 33-MHz 68030 processor and

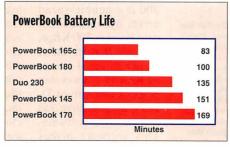
68882 FPU as does the PowerBook 180. But there's no mistaking the two because of the 165c's passive-matrix color LCD screen. The smaller 9-inch panel uses a higher dot density to achieve the same 640- by 400-pixel resolution as the 180 while displaying 256 colors. The 165c's display is clear and bright, but you have to adjust the brightness to maximum (thereby taxing the battery) to see it at its peak. Typical of passive LCD technology, the 165c's display also exhibits display artifacts (colored streaks) as cross-talk volt-

ages leak to adjacent pixel lines. Nevertheless, several BYTE editors (not just me) judged it to be the best passive-matrix screen they've seen.

The low-level BYTE benchmarks gauged a PowerBook 165c (with 4 MB of RAM and an 80-MB hard drive) similar in performance to the PowerBook 180, except for video. PowerBook 165c designers used DRAM, rather than dual-port-

ed VRAM (video RAM), for the frame buffer. Because the processor and display circuitry battle over access to this memory, video performance suffers. The slow display hampers throughput, causing some application benchmarks to plummet to apparent Mac IIvx speeds. Since the rest of the computer operates at 33 MHz, the performance penalty appears only when an application makes heavy use of the display. I hope future color Power-Books avoid this design flaw.

While 256 colors seems limiting, it's adequate if you need to run small group presentations and need to carry a bare minimum of hardware. You might not want to edit anything in Adobe Photoshop on the 165c, but professional artists can use Photoshop to present portfolios of their work or to preview artwork while traveling.



Thanks to the ground-breaking Quadras, software compatibility for the 68040-based Centris 650 was excellent. Aldus Page-Maker 4.2, Symantec's Think C 5.0.4, and Zedcor's FutureBasic 1.01 all ran without a hitch. Scanning color images using Light Source's Ofoto 2.0 and an Apple Color OneScanner also went without problems. Adobe Photoshop 2.5 blitzed through loading and editing huge image files.

The Centris represents a great step forward, providing excellent performance and solid compatibility for a price that puts it in direct competition with high-end PCs. If there's one thing wrong with the Centris 650, it is—ironically—the price. Or at least the pricing structure. Prices between related Mac models usually differ by only a few hundred dollars, but the difference between a similarly equipped Centris 610 and Centris 650 is closer to \$1000. ■

Tom Thompson is a BYTE senior technical editor at large and a certified Apple developer. You can reach him on BIX as "tom_thompson" or on the Internet at tomt@bytepb.byte.com.

About the Products Centris 650\$3939 Apple Computer, Inc. 20525 Mariani Ave. **PowerBook** Cupertino, CA 95014\$3399 (800) 776-2333 (408) 996-1010 **DayStar Digital** fax: (408) 974-6412 Turbo 040\$1599 Circle 1221 on Inquiry Card. System Configuration Centris 650: 8 MB of **DayStar Digital** RAM, 1 MB of VRAM, 5556 Atlanta Hwy.

230-MB hard drive,

PowerBook 165c: 4

MB of RAM, 80-MB

CD-ROM drive.

hard drive.

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DOS OF Problems! Safety in Numbers

Safe Memory Management Keeps Your System Running Smoothly.

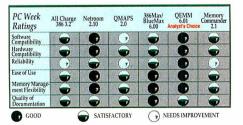
What's more annoying than losing work on your PC? A crash or 'hang' destroys everything you've done since the last time you saved. That work is lost forever.

Two major causes of crashes are memory conflicts and running out of memory. To avoid these problems, many users sacrifice productivity-enhancing TSRs or useful network utilities. And that's unfortunate, because the right memory management lets you have it all—safety and performance.

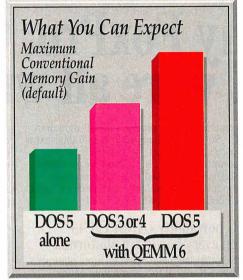
Have Your Cake and Eat it, Too.

QEMM-386[™] version 6 lets you run your favorite programs and TSRs without fear of 'out of memory' problems or conflicts. It provides the maximum memory right where your programs need it.

The more memory you have, the more reliability you get. No other memory manager measures up to QEMM's performance.



PC Week carefully compared them all and rated QEMM-386 v6 the best memory manager.



This is what QEMM-386 does for a typical PC. It reorganizes memory to produce greater speed and safety.

Nobody Knows Memory Like We Know Memory.

That's not bragging, just fact. As recently as two years ago, DOS ignored the importance of maximizing conventional memory. At that time, our QEMM-386 v5 provided up to 128K more usable memory. QEMM became a virtual necessity for 'power users'

Today, our latest QEMM-386 version 6 surpasses even that achievement. Thanks to our new, smart 'stealth' technology, it finds as much as 96K more high memory than other memory managers. And speaking of other memory managers, not one has yet been able to match our performance. Instead, some have slashed prices or started nasty rumors just because they couldn't reliably deliver the same results. These tactics must not work, since we outsell all the others put together.

QEMM. The Memory Manager Millions Rely on Every Day.

Considering its unsurpassed performance and the safety it adds to your system, it's no

wonder that millions of PC owners use OEMM. And it should be no surprise that 'gurus' and MIS managers consistently vote QEMM-386 the top memory manager in poll after poll, year after year.

QEMM comes with

Manifest, the



QEMM has won more recognition than all other memory managers combined.

Protect Your Productivity; Keep Your Work Safe.

Any task, from programming to writing the company business plan to composing a personal letter, takes time and thought. Your PC is supposed to make that process easier;

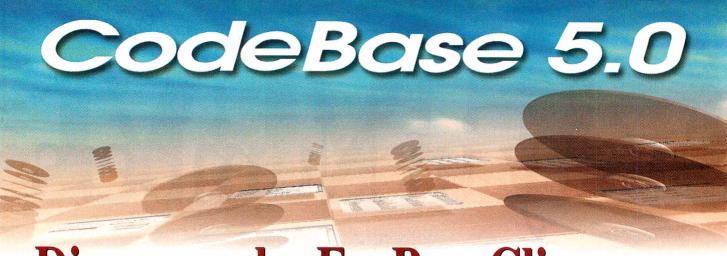
your output better. When you can't run your favorite grammar-checking TSR or have to get by without a vital network utility, you're sacrificing productivity.

Whether you're PC-DOS, DR DOS or

award-winning memory analyzer that helps you avoid memory running MS-DOS, IBM™ conflicts. MS Windows, don't

sacrifice; don't compromise; don't risk losing work. QEMM-386 version 6 is the most powerful, flexible memory manager you can buy. Period.

Quarterdeck Office Systems, 150 Pico Boulevard, Santa Monica, CA 90405 (310) 392-9851 Fax (310) 314-4219 Quarterdeck International Ltd., B.I.M. House, Crofton Terrace, Dun Laoghaire Co. Dublin, Ireland Tel. (353) (1) 284-1444 Fax: (353) (1) 284-4380



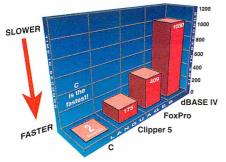
Discover why FoxPro, Clipper, and dBASE were all written in

here is a good reason why your database language was developed in C. In fact, there are many good reasons.

C code is small. C code is fast. C code is portable. C code is flexible. C is the language of choice for today's professional developer. With the growing complexity of database applications, C is a realistic alternative. Now with CodeBase 5.0, you can have all the functionality, simplicity and power of traditional database languages together with the benefits of C/C++.

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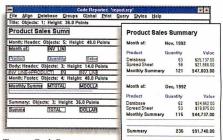
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Microsoft's Visual C++

It's not quite Visual Basic gone to C, but this enhancement to C++ 7.0 removes some of the drudgery of Windows programming

JIM HURD

icrosoft's Visual C++ brings welcome, sweeping changes to the Microsoft C/C++ 7.0 programming environment. The familiar character-mode Programmer's Workbench IDE and CodeView debugger are replaced in a single stroke by Visual Workbench. The menagerie of resource-creation and editing tools on which most Windows programmers cut their teeth is superseded by an all-in-one resource utility called App Studio. A new version of the Microsoft Foundation Classes (MFC 2.0) greatly enhances the value (and doubles the size) of Microsoft's application framework. Taken together, these changes represent a major shift toward removing some of the common hurdles C and C++ developers face when moving to Windows.

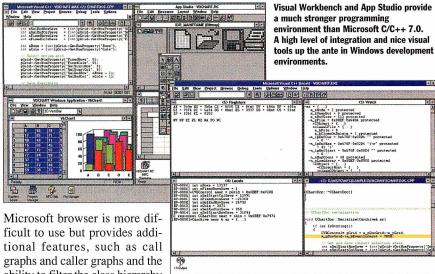
But Visual C++ won't do for C++ what Visual Basic did for BASIC. Visual C++ has little in common with Visual Basic other than its ability to use VBX-style controls. However, the common ground that VBX controls provide is important: It's the path that makes it possible to prototype in Visual Basic and move to a finished application in C++.

Visual Workbench

Visual Workbench is an integrated development environment that replaces C/C++7.0's Programmer's Workbench. With a full-blown Windows interface, an integrated debugger, and background compilation, Visual Workbench goes far beyond its predecessor.

Visual Workbench provides a straightforward cut/copy/paste editor similar to the one in Borland C++. Like Borland's IDE editor, the Visual Workbench editor can highlight code syntactically—for example, keywords in red, comments in green, and preprocessor instructions in blue. This may seem trivial, but it helped me catch bugs that are easily missed.

The source browser from Programmer's Workbench gets a Windows face-lift in Visual C++. Compared to Borland's browser, the



graphs and caller graphs and the ability to filter the class hierarchy for selected symbols. For basic browsing, neither is superior. Unlike tra-

browsing, neither is superior. Unlike traditional browsers (but like Borland's), the Visual Workbench browser does not let you view or edit code directly. Instead, clicking on a method moves you to the editing window, opening one if necessary.

Microsoft's first Windows-hosted debugger, a component of Visual Workbench, is short on bells and whistles. It doesn't offer the wide feature set of the MultiScope debugger, but fortunately it is more robust. As with the debugger in Borland's DOS IDE, you can set breakpoints at any time and jump directly into the editor when you find a bug. This high level

The debugger integrated into Visual Workbench. It's Windows-hosted (finally), but its features are those common to many other debuggers, and it doesn't support remote debugging. Visual C++ also ships with CodeView.

of integration translates to increased productivity. However, I still had to use Nu-Mega's SoftIce to trap the nasty bugs. And since the Visual Workbench debugger doesn't support remote debugging, you need to use a large monitor to give yourself enough space for both debugger and target application. I missed the ability to debug code on another machine, but not badly enough to use CodeView (also included with Visual C++).

MFC 2.0 FEATURES

- Printing, including print preview
- Multiple Document Interface, with toolbar and status bar
- Split windows for VBX controls
- Dialog box controls in windows
- Drag-and-drop file manager support
- . OLE
- Context-sensitive help
- Code placed in shared DLL

App Studio

Like Borland's Resource Workshop, App Studio integrates a collection of resource editors, including editors for dialog boxes, menus, bit maps, icons, cursors, and string tables. App Studio goes beyond Resource Workshop with its Class Wizard, support for VBX controls, and a superior user interface.

The Class Wizard forms the link between App Studio and Visual Workbench. Programmers can select a control in App Studio and quickly jump to the code in their program that implements that control. If you haven't written the code

Reviews Microsoft's Visual C++

EXECUTION SPEED

Using Thomas Lane's JPEG file-compression utility, I tested the execution speed of Visual C++ versus Borland C++ running under Windows. Execution times, in seconds, are shown for speed-optimized 386 code in both cases.

	BORLAND C++ 3.1	VISUAL C++
JPEG to PPM	6.6	6.8
JPEG to GIF	16.6	20.0
PPM to JPEG	11.5	8.6

yet, the Class Wizard whips up a simple template.

Unlike the Application Wizard (described below), which is used once to set up a project, the Class Wizard is in constant use. The Class Wizard's main purpose is to map Windows messages to appropriate methods that you define; adding a new menu command is a reason you might invoke the Class Wizard. However, you can also use it as a simple browser.

App Studio supports VBX controls. Importing a VBX control integrates it into

the control palette along with the standard Windows controls (e.g., button and check box) and makes its properties accessible through the property editor. Through the Class Wizard feature, App Studio can generate code for mapping VBX messages to C++ methods. The ease of using off-the-shelf VBX controls is a big plus for Visual C++ programmers. In testing Visual C++, I often added features in the form of VBX controls that I would not otherwise attempt.

VBX controls are convenient, but they don't replace a good class library. Compared to using grids with MacApp, for example, the VBX grid control is easier to implement but not as flexible. The VBX grid can hold text, numbers, or pictures, but the MacApp grid class can be subclassed to display whatever you want. Also, many of the VBX controls are cosmetic adjustments that add little functionality. Still, I often found VBX controls to be the shortest path to a finished product.

The real solution, of course, is to use a

class library where you need a class library and a control where you need a control. Fortunately, Visual C++'s MFC 2.0 class library is no slouch. MFC 2.0 can dramatically reduce the amount of code needed for a basic Windows program by providing an architecture and a set of prebuilt components. Unlike its predecessor, MFC 2.0 adds real functionality to programs that use it. MFC eclipses other Windows frameworks, but it still has a number of weaknesses compared to some application frameworks, notably MacApp.

The Application Wizard feature provides a quick way to create all the files needed to start a new project using the Microsoft Foundation Classes. The Application Wizard is like a shell script on steroids: Check items in a dialog box, specifying a few names and planned application features (such as OLE or drag and drop), and the Application Wizard creates a project directory complete with make file and basic application shell. By using the Application Wizard, I quickly created the shell for an OLE test application that instantly had the basic menus, toolbars, and so on.

The Deciding Factors

Visual C++ is not the perfect compiler. Compilation can take two to three times longer than it does with Borland C++ 3.1. If you don't muck around with Microsoft's tedious precompilation procedure, the difference can be a factor of 10. The quality of generated code is roughly equal to that of code from Borland's compiler (see the table "Execution Speed"). Visual C++ is still based on CFront 2.1. Templates, exceptions, and flat-model 386 code generation didn't make it into this release.

Still, Visual C++ clearly sets a new target for the quality of development environments. It's a stunning upgrade that should be immediately embraced by anyone using Microsoft C/C++ 7.0. Users of other compilers will have to weigh the advantages of Microsoft's advanced environment and application framework against the lack of templates and relatively slow compilation. You may find that you have a place for more than one C++ compiler in your soft-

ware toolbox.

Jim Hurd is vice president of R&D at National Software Testing Laboratories (Plymouth Meeting, PA). You can reach him on BIX c/o "editors."

About the Product

Visual C++\$499 Microsoft Corp. 1 Microsoft Way Redmond, WA 98052 (800) 227-4679 (206) 882-8080 Circle 1229 on Inquiry Card.

Key Application Framework Classes

Mac programmers will feel at home with Visual C++'s new Microsoft Foundation Class libraries: Much of the new terminology and architecture have been borrowed from MacApp. Here are a few key classes:

CObject supports run-time class identification, streams, and collections.

CCmdTarget command targets are objects that take part in the dynamic command routing. Menu commands, for example, traverse the command chain until "handled" by a command target.

CDocument objects manage an application's data. **CDocument** subclasses inherit default file-interface functionality, such as load, save, and save as.

CWinApp does many things for MFC applications automatically, such as maintaining the Windows menu and updating the list of recently used documents. Every MFC application has a class that descends from CWinApp. The single instance of this class is the application object.

CVBControl supports use of Visual Basic controls within Visual C++ programs.

CView objects are responsible for displaying data. These objects manage screen repainting and printing.

CFormView allows windows to be created in App Studio using the same tools used for dialog creation. Unlike dialogs, form views can be resized and scrolled.

CEditView provides basic text editing in a view wrapper. It's limited by functionality of the Windows edit control—one font, no styles, and a limited amount of text.

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Until now, data files, such as database files, downloaded mainframe files, Postscript and plotter output, .EXE executables and other non-standard files were a real headache if you ever had to view, patch, search, replace or extensively edit them.

Traditional text editors can't handle these files because they are non-standard or too big. Traditional disk utilities allow only the most primitive viewing and patching. Just a single corrupted data file could take days to fix, and you sweated and cursed the whole time.

A new way to handle data files

VEDIT lets you edit data files as effortlessly as text files. Its secret is incredible speed, huge file capacity and special editing modes.

File modes support DOS, Unix and Mac style text files plus data files with fixed length or variable length records. Display modes include five ASCII modes, Hexadecimal and EBCDIC, or split the screen for any combination. Search using pattern matching or regular expressions, cut and paste data files, and much more. Long lines can be horizontally scrolled or wrapped onto multiple screen lines.

Handle nasty "text" files too

Text files may sound easy to edit, but other editors choke when they hit embedded control (null) characters, very long lines or the 400 Megabyte file you are trying to put onto a CD-ROM. VEDIT handles all text files effortlessly and automatically detects the correct file type. With VEDIT you can conveniently edit any file you will ever encounter.

Speed, speed, speed

Only VEDIT has the speed to edit multi-megabyte files. Traditional text editors such as Brief(tm) and Sage(tm) are much too slow to edit files much larger than memory; and Multi-Edit(tm) is 7 times slower than VEDIT. And none of them can efficiently edit data files.

-01 lauge	VEDIT	Brief	Multi-Edit	Sage
Edit data/binary files	Yes	No	Some	Some
Support fixed-length record	ds Yes	No	No	No
Maximum line length	Unlimited	512	2048	65K
Maximum file size	2000 Meg	32 Meg	32 Meg	100 Meg
Hex/EBCDIC editing	Yes/Yes	No/No	No/No	No/No
Multiple display modes	Yes	No	No	No
Fast browse of CD-ROM	Yes	No	No	No
Global search/replace				25/81 N. Ph
in 10 Meg file	2:49 min	>24hours	20.0 min	2:10 hour

Ultimate programmer's editor

Long a favorite among programmers, VEDIT has every advanced feature you might expect. Simultaneously edit numerous files, split the screen into windows, search/replace with regular expressions. Automatic indent, block indent, parentheses matching and block operations by character, line, file or column speed program development. Word wrap, paragraph formatting, justification, centering and many printing options are ideal for text processing.

Its unique compiler support integrates tools from different vendors and fully supports "make". VEDIT PLUS has the most powerful macro programming language of any editor. It's ideal for translating files from one format to another.

Easy to learn, easy to use

An intuitive user interface with drop down menus, hot keys, mouse support, optional scroll bars, context sensitive help, point and shoot file selection and unlimited keystroke macros make VEDIT PLUS easy to use, easy to learn. Safety features include 1000 level undo, auto-save and optional backup files.

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The entire keyboard layout and everything in VEDIT is configurable with easy to use menus. With over 100 configuration parameters you can fine-tune VEDIT to your exact needs and preferences.

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Two Roads to Windows Databases

Paradox for Windows and FoxPro 2.5 for Windows migrate from DOS. One's good for a client-server setup; the other's built for speed.

STAN MIASTKOWSKI AND MARC SCHNAPP

f there's one thing you can be certain of these days, it's that wherever you find Borland, you'll also find Microsoft. So it's not surprising that both companies have moved well-established DOS database managers to Windows—though each by a different route. Borland has redesigned Paradox to fully exploit OOP (object-oriented programming), while FoxPro 2.5 for Windows remains true to its Xbase heritage and still boasts blazing speed on demanding jobs.

Paradox for Windows



Paradox, Borland's powerful relational database program, has evolved through four DOS versions during the past decade. The latest incarnation, Paradox for Windows, is a complete rewrite and redesign, including aggressive object-oriented ac-

Data Access and Connectivity

The heart of Paradox for Windows is the Borland InterBase Engine, a core technology that will be the heart of all the company's database products. The InterBase Engine's biggest advantage is that it offers potential native access to a wide range of data formats.

The first release of Paradox for Windows lets you use Paradox and dBase (.DBF) files. Borland promises SQL access within the next few months, to be followed by modules for Interbase, Oracle, and Microsoft/Sybase, among others. The important thing to underline about the InterBase Engine is the native data access. No exporting or importing is involved. We

were easily able to create a sophisticated linked database that used a mix of both Paradox and dBase files.

Paradox has always offered extensive built-in multiuser support, which has been extended with Paradox for Windows. In a network setup, multiple users can work with data on a central server running Paradox for Windows. File and record locking is automatic, and the database owner can further restrict access to files through read and write locks.

Creating a new database with Paradox for Windows isn't much different from using any Windows database. You do have a few choices, however, such as choosing whether you want to use Paradox for Windows, Paradox 3.5, or dBase format.

Paradox for Windows offers some unique field types, although they're not exportable to other database managers. Besides the standard database fields, Paradox for Windows has *dynamic memo* and *formatted memo* fields that are useful for storing large amounts of text. The formatted memo field lets you give rich text attributes such as font, size, and color to stored text.

Stored data is often more than text, so Paradox for Windows also has two other unique field types: *graphic* and *BLOb*. As the name implies, graphic fields hold standard graphics file formats, including BMP, EPS, GIF, TIF, and PCX. BLOb (Binary Large Object) fields hold virtually any type of binary data. In a database environment, you're likely to use BLObs for audio and motion-video files, or perhaps a CAD drawing. *OLE* fields are a specialized form of BLObs. Using Windows' Object Linking and Embedding, they let Para-

dox for Windows act as an OLE host. Clicking on an object in an OLE field launches the associated application.

More Than a Windows Interface

Paradox for Windows' Database Desktop interface is new and completely different. The interface makes everything that appears on the screen an object that you can manage and manipulate. Paradox for Windows is the first major Windows application that's completely object-oriented. From a user-interface standpoint, objects are primarily visual entities that encapsulate (i.e., hide) packets of code and data. That's one reason it's so difficult to explain how the interface works in Paradox for Windows. You have to see and use it. The Object Inspector is the key to the object-oriented interface. When you point to anything on the screen and click the right mouse button, you see a menu showing all the properties that are associated with the object.

One familiar feature of Paradox for Windows is QBE (Query by Example). Paradox was the first to incorporate it into database technology, and it works much the same way in Paradox for Windows as it does in the DOS version, although it's more graphical. Creating a query is still a matter of checking the fields you want to search and entering search criteria. It remains one of Paradox's most powerful features.

Form and report design has been vastly extended in Paradox for Windows. The program's aggressive object orientation makes the process more obvious and considerably more capable.

Data Modeling

Paradox for Windows extends Paradox's data models. You can use the usual single and multifield primary indexes, but you can also use secondary indexes. This powerful concept can dramatically speed up operations as well as create complex relationships among tables.

The program has many data-integrity

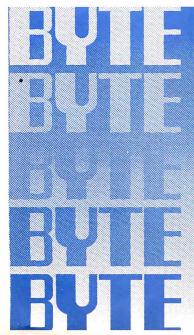
THE ROADS TAKEN

Paradox

- Object-oriented
- Multiuser support
- Native access to a wide range of data formats via InterBase Engine
- · Graphical query by example

FoxPro

- Xbase-oriented
- Multiuser support
- Superb speed via Rushmore query-optimization technology
- RQBE with optimized SQL links



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NO POSTAGE NECESSARY IF MAILED IN THE UNITED STATES features. Most notable is referential integrity using foreign keys. This lets a database contain rules and conditions about what you can and can't do with its data. Also important is domain integrity, which lets you specify a valid set of values for a field.

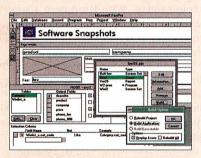
Paradox for Windows shines at constructing extremely complex data relationships. The program's graphical object-oriented approach helps cut through the complexity of creating relationships such as one-to-many-to-many-to-many-to-one.

Application Development

Paradox for Windows' Database Desktop has all the tools necessary to create a wide range of databases. But if you want to do more, there's ObjectPAL. The successor to the DOS version's PAL (Paradox Application Language), object-oriented ObjectPAL is itself a paradox because of its range.

A user without programming experience can easily use ObjectPAL to customize an application. For experienced developers, ObjectPAL is a powerful application development environment that lets you use either its custom programming language or a visual drag-and-drop approach. There's a downside: PAL programmers have a great deal new to learn. It's also very difficult to convert existing PAL programs to ObjectPAL.

FoxPro for Windows



Don't think of FoxPro 2.5 for Windows only as a Windows DBMS—although it certainly is a respectable one. As the first Windows incarnation of FoxPro, FoxPro for Windows' key strength is its ability to quickly migrate DOS FoxPro applications to Windows. FoxPro applications will run with minimal adjustments on both the DOS and Windows sides and are also compatible with dBase III Plus and dBase IV.

The New Face

FoxPro 2.5 for Windows' user interface is close to that of FoxPro 2.0, although

some menus and menu items have been shuffled to accommodate Windows conventions. For instance, the Windows version eliminates the DOS menu bar and places its utilities in the Help menu. In addition to the common Windows menu bar, FoxPro for Windows features a command window into which you can type Xbase commands. The main screen area becomes the TTY terminal for feedback on interactive commands. You can create MDI (Multiple Document Interface) child windows using Xbase DEFINE WINDOW commands or by invoking data-manipulation surfaces and design tools. FoxPro includes a screen painter with a user-modifiable Xbase template file to generate Xbase code.

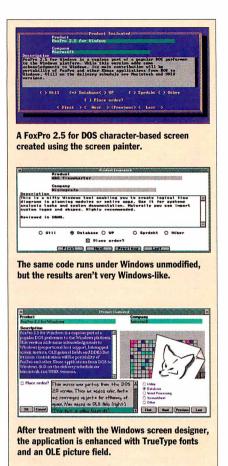
FoxPro for Windows' screen painter, report generator, and label maker let you manipulate screen objects directly, but this is not by any means an OOP environment. FoxPro's programming language is a dialect of procedural Xbase. Applications written using the supplied design tools can be moved back and forth between DOS and Windows using a "transporter" tool. To exploit DDE, FoxPro for Windows adds commands that turn FoxPro into a DDE server or client.

Leaving the Shadow of dBase

The FoxPro series was designed to live in a dBase world. FoxPro for Windows' underlying dBase-clone heritage becomes quickly evident when you examine the Xbase code it generates. FoxPro for Windows comfortably runs dBase III Plus code. However, there are still semantic differences between FoxPro for Windows and dBase IV. Microsoft has created a dBase IV Migration Kit to move dBase IV programs into FoxPro. The kit centers on a FoxPro application that analyzes the syntax of dBase programs.

FoxPro for Windows makes several significant leaps over dBase IV. FoxPro adopted dBase IV's concept of a single file holding multiple index expressions. This means that indexes are continually updated as data is entered into tables. FoxPro amplifies the idea by using its own file structure with bit-mapped indexes and advanced query optimization.

To gain the most from FoxPro, you index just about every field. With queries that include matches against multiple fields, FoxPro can generate fast result sets by finding the union of records with hits in the various indexes. FoxPro uses query-optimization technology, known as Rushmore, which has been responsible for up-



ping market standards in PC database performance.

Data Access and Types

Although Microsoft has touted ODBC (Open Database Connectivity) as a solution for universal connectivity to various databases, FoxPro 2.5 has no access to SQL database servers. FoxPro for Windows can access dBase III and dBase IV tables and will generate FoxPro index files automatically on the first access. FoxPro data can be exported to ASCII, dBase III, DIF, SYLK, WK1, WKS, WR1, and Excel formats.

Like previous versions, FoxPro for Windows supports multiuser operation. DOS and Windows versions of FoxPro respect each other's locks. No new commands have been added to the existing set of record- and file-locking and error-handling constructs.

FoxPro for Windows continues to use fields that can hold binary data. There is also a new General field type. FoxPro for Windows is an OLE client. By defining a field as type General in a table, you reserve a space for linked or embedded objects. There are no menu options to invoke

Performance Comparisons

RICK GREHAN

tested the performance of FoxPro 2.5 for Windows and Paradox for Windows with a subset of the BYTE Lab/NSTL database benchmarks. These benchmarks consist of four transaction tests and three queries. Running the benchmarks required porting them from their DOS origins to the Windows environment. FoxPro for Windows happily recompiled the benchmark source code and was ready to run in just minutes. However, I had to completely rewrite the PAL source code written for Paradox to work with Paradox for Windows' ObjectPAL.

The tests simulate database operations for a book order-entry system using five tables: book, author, link (for associating author names to book titles), orders, and entry (where each entry record represents a line item attached to an order). I ran all the tests on a Gateway 50-MHz 486DX laptop with 7 MB of RAM and a 120-MB hard drive. The results (in seconds) appear in the table.

The Results

On the simple queries, Paradox does well. The first query test involves a single-table search, and Paradox outdoes FoxPro by a hair. The second query requires a threetable join, and again Paradox hits the finish line ahead of Fox-Pro, although this time the lead is healthy. However, in the third query—a demanding fivetable join—FoxPro shines. FoxPro's secondary indexes and Rushmore optimization seem to give it the edge on more complex data sets.

In the transaction tests, Paradox does well across the board. Transaction test 1 requires an exact search, and Paradox does marginally better than FoxPro. Transaction test 4 is a simple update test, requiring an exact search as in test 1, and again Paradox is slightly faster.

Transaction tests 2 and 3 are more complex, requiring a search of a large table (25,000 records in one case) using an inexact key. ObjectPAL's set-Filter method, which enables you to create a restricted view of an otherwise huge index, enabled Paradox to outrun FoxPro's seek command.

Overall, it appears that Paradox for Windows has the upper hand. The engine beneath the new Paradox is a complete rewrite of the engine living beneath the DOS version of Paradox. Borland's engineers claim that this new engine contains both ISAM-type (indexed sequential-access method)

operations and table-type operations. From a performance standpoint, the rewrite was obviously a success.

Rick Grehan is technical director of the BYTE Lab. You can contact him on BIX as "rick_g."

BENCHWARK RESULTS				
	FOXPRO	PARADOX		
Query tests				
#1	5.14	4.50		
#2	67.23	34.01		
#3	15.41	36.77		
Transaction tests				
#1	12.53	10.86		
#2	48.97	28.49		
#3	29.75	21.05		
#4	4.83	284		

DEMOURABLE DECLIE TO

OLE, but FoxPro for Windows adds a new APPEND GENERAL command to store objects in a table under program control.

RQBE

The nongraphical RQBE (Relational Query by Example) procedure for joining FoxPro tables lets you select picklist items for tables and join conditions. FoxPro sup-

ports outer joins, and the table browser will display one-to-many relationships. RQBE results are directed to the user's choice of a temporary cursor, a browse table, a stored DBF table, a report, a label, or a graph. Selecting a graph output invokes a graph "wizard" that aids the user in selecting from an Excel-like gallery of charts.

The RQBE module generates a unique FoxPro flavor of SQL that runs queries against DBF files. In addition to the standard SQL aggregate functions, FoxPro SELECT statements can include Xbase functions and expressions. Optionally, you can preview SQL code and save it for reuse.

FoxPro's RQBE and Rushmore queryoptimization technology are intimately linked. Although Xbase programmers have always been able to link files, FoxPro cannot optimize these links; it can optimize only the performance of SQL joins. The RQBE facility is an easy way to do so.

Which for Windows?

Paradox for Windows pushes the edge of database technology while retaining surprising ease of use. The product has layers of features and abilities. The heavy-duty marketing battle between Borland and Microsoft over dominance in the growing database market unfortunately gives the impression that high-end databases are easy-to-use necessities for nearly every computer user. That's not the case. Paradox for Windows is most comfortable in a client-server environment handling huge amounts of data.

FoxPro for Windows benefits from userinterface refinements and language enhancements, but its real value is in its heritage; it's simply the most formidable Xbase contender now available. It offers a potent combination of high performance, slick tools, and a smooth multiplatform migration path that Xbase developers can exploit today. With Rushmore's superb

response time, and good application design tools, FoxPro is a strong tool for downsizing applications with massive data sets that require speedy interactive queries.

Stan Miastkowski is a BYTE consulting editor and a Paradox user and developer. You can contact him on BIX as "stanm" or via MCI Mail at 530-9979. Marc Schnapp is acting chairman of X3J19, the ANSI committee for Xbase language standardization. You can reach him on MCI Mail at 172-5429 or on CompuServe at 73767,517.

Product Information

Paradox for

Windows\$795 Borland International, Inc.

1800 Green Hills Rd. P.O. Box 660001 Scotts Valley, CA 95067 (408) 438-8400 fax: (408) 438-8696 Circle 1227 on Inquiry Card.

FoxPro 2.5 for Windows\$495

Microsoft Corp. 1 Microsoft Way Redmond, WA 98052 (800) 426-9400 (206) 882-8080 fax: (206) 936-7329 Circle 1228 on Inquiry Card.

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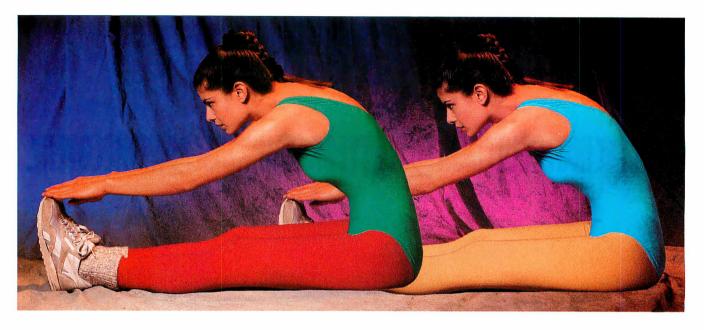
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HP's Simple Laser

4-ppm printer that breaks new ground—not your desk or your budget

HOWARD EGLOWSTEIN

he days of having a laser printer on the network and a dot-matrix printer on the desktop may be drawing to a close. As shared resources, laser printers give you crisp-looking, classy documents, but you sacrifice convenient access and document privacy.

Hewlett-Packard's new low-end Laser-Jet 4L will break that mold. It brings the output quality of a 300-dot-per-inch laser printer to individual desktops. It includes the attributes that have made dot-matrix technology the choice for most personal printers: low cost, simple operation, and an unassuming footprint. What it lacks is speed and the expandability you might expect from high-end lasers.

The LaserJet 4L comes in two varieties. The 4L is a PCL-only (Printer Control

Language) printer for DOS and Windows users, while the 4ML serves Mac clients as well, with both Post-Script and PCL support. Both are compact, 4-pageper-minute, 300dpi lasers with very unlaserlike prices: the 4ML.

Both printers are equipped with HP's Resolution hancement Tech-

nology (RET) and a new flavor of PCL, PCL5e. Each unit is just over a foot square and weighs less than 16 pounds. I tested the 4L, but the 4ML shares many of the same new features, although the extra \$430 on the 4ML's price tag brings significantly more capability. The 4L comes standard with 1 MB of RAM and an MC68000 processor, while the 4ML is packed with 4 MB of RAM, a more powerful Intel 960 processor, PostScript Level 2, and a LocalTalk port. The 4ML also offers automatic port sensing, automatic emulation sensing, and a full complement of Post-Script fonts.



 $\$849\ list\ for\ the\ 4L$ $\,$ THE LASERJET 4L skips the usual front-panel controls and \$1279 list for in favor of a TSR and DOS-utility combination called Explorer. Explorer lets you adjust the print intensity, determine the number of copies, and choose among fonts without having to navigate through the branches of traditional front-panel push-button menus. It can also pop up alerts on jams or out-of-paper conditions.

The 4L embodies a lot

of new technologies, but the technical advances are mostly directed toward increasing ease of use and lowering cost. These include Explorer control software, Memory Enhancement Tech-

nology (MEt), and other significant improvements.

Look closely and you will notice (or rather, *not* notice) the front control panel. Instead of the usual LCD and buttons. you'll see just one button and four status lights. With the 4L, you control output by activating HP's Explorer, a TSR control program on your PC. Explorer's remote control uses HP's Bi-Tronic technology. This allows information to travel back and forth between the printer and PC via the parallel port. If you run out of paper or some other error occurs, an optional popup mode that monitors the printer's status breaks into your DOS application with appropriate messages.

HP's new LaserJet 4L printer is designed

for personal use. The front panel is replaced by

a set of software utilities. A PostScript version (the 4ML, not shown) adds PostScript and an Apple LocalTalk

port to the standard PCL5e and parallel-port configuration.

The 4L's single front-panel button takes the printer on- or off-line, resets the printer, and outputs test pages. The 4L doesn't even have a power switch. HP says its research indicated most users leave their printers on at all times, so the 4L was designed with automatic power control. The 4L remains on as long as it's plugged in. About 15 minutes after the last print job, the printer shuts down everything except its processor. Total power draw in standby mode is only 5 W. Sending a print job to the 4L reactivates it, preserving all previously set modes and downloaded fonts.

The 4L's complement of 1 MB of memory sounds skimpy. However, with MEt, 1 MB of printer memory should be enough for printing anything you could send to a 300-dpi printer. MEt extends memory use by compressing fonts before saving them during the initial download. MEt also exposes graphical data to a variety of compression algorithms to conserve as much memory as possible. If that doesn't do the

Reviews HP's Simple Laser

trick and there still isn't enough memory to print a given job, an Image Adapt mode kicks in and removes just enough fine detail to fit the page into the buffer. If you don't want to sacrifice the finer graphics, you can turn Image Adapt off and opt for a 1-MB upgrade.

The LaserJet 4L is simpler to maintain than traditional laser printers. It's built around a new Canon print engine that has no corona wire and fewer parts to clean. You can also save toner by printing proofs in Economode. Similar to the draft mode on many dot-matrix printers, Economode prints each page with half the usual amount of toner. This feature saves money and makes your toner last longer.



ADJUSTABLE PAPER TRAYS are common, but the mechanism on the 4L's single tray is unique. An adjustable stop on its single tray slides along a special track and locks in settings for 81/2- by 11-inch. executive, and B5 sheets. The tray is sized for standard A4 paper, but it also prints envelopes, labels, and transparencies. To fit legal-size paper, the slide juts off the end of the tray, allowing the paper to stick out the back of the printer.

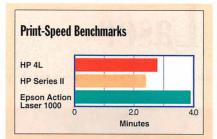
The 4L ships with Windows 3.1 drivers, drivers for many popular DOS applications, and HP's Explorer. Installing the drivers is predictably simple. A Windows application takes care of copying the drivers, checking your Windows configuration, and setting your default printer driver. The DOS application drivers are similarly easy to install. If your application doesn't support PCL5e, you can use LaserJet II. III, or 4 drivers with the 4L.

The 4L's simplicity introduces some

limitations if you'd rather coerce a 4L into an inexpensive shared resource. Swapping the front panel for a clever software solution means you can't use print-sharing devices unless they pass all the signals directly from *your* computer to the printer. You can't use the 4L with electronic sharing switches or most mechanical switch boxes, and you can't control it across a network.

Someday Your Prints Will Come

Making a printer smaller, lighter, and less expensive has its drawbacks. The most obvious of these is speed. The 4L's print engine is rated at 4 ppm, but I was able to achieve this speed only by sending a series of sparse pages, printed entirely in one font. Effective speed with standard busi-



On a series of five mixed text and graphics pages, the 4L was almost 30 percent faster than the more expensive Epson Action Laser 1000 (also 4 ppm). The 4L was slightly slower than the full-size (8 ppm) Series II. The Series II was only a few seconds faster in spite of its faster-rated print engine. The 4L uses data compression to speed up data transfers.

ness documents (mostly text) was closer to 2 or 3 ppm.

To get a quantitative measure of the 4L's print speed, I put together a number of test documents with a variety of fonts and bit-mapped graphics. I compared results for the 4L, an Epson Action Laser 1000, and a near-antique HP LaserJet Series II with 4.5 MB of memory.

The figure "Print-Speed Benchmarks" shows the results of printing a mixed text and graphics test document on each of these printers. For each printer, I installed the appropriate print driver (PCL5e for the 4L and the standard Windows Series II driver for the others) and used a second computer to capture the printer data stream. The results shown in the figure indicate the time required to copy the captured data to the printer. Printing from Windows rarely yields consistent results due to its internal task switching and memory management. Capturing the data stream eliminates these variables.

The two HP printers flew through the test much faster than the Action Laser. For a mixed document, a variety of factors affect performance; the Series II's 8-ppm print engine was a definite advantage on the simpler pages, while the data-compression algorithms built into PCL5e gave the 4L an edge on the graphics-intensive pages.

The 4L's small size is great for fitting on your desk. The trade-off is its lack of expansion options. The 4L has no font-cartridge slots, it doesn't take third-party upgrade cards, and you can't add memory beyond 2 MB. If you want Post-Script, you'll have to purchase the 4ML instead of the 4L—there is no 4L-to-4ML upgrade.

In general, the 4L's output quality is excellent. HP's RET works by tracking the outline of solid graphical areas and adjusting dot position (from the standard 300 by 300 grid) to make outlines smoother. It's not the same as using a higher resolution, but it can give that illusion. RET on the HP 4L gave its output an edge over that of similarly priced printers like the Action Laser.

An informal poll (I passed print samples around BYTE) easily placed the 4L's text quality higher than the Action Laser's. It also fared better than the Series II, and its quality was better than that of a preproduction Texas Instruments microWriter (see First Impressions, April BYTE). However, I also took a more critical look at graphics samples from the 4L, examining the effects of the printer's dithering algorithms, tonal range, and coverage. The 4L's graphics displayed noticeable posterization in areas of fine detail. Both the Action Laser and the LED engine in the microWriter produced better detail and tonal range than the HP printers.

The Canon SX engine that usually runs in the Series II (and many other 8-ppm printers) prints washed-out, streaky blacks; the LaserJet 4L's microfine toner cartridge prints better. However, the HP Series II that I used for comparison was running a special third-party graphics toner cartridge (Black Lightning, Hartland, VT) that prints good, solid blacks, better than those produced by the LaserJet 4L.

A Pitch for Selfishness

Why consider a 4L? You may be printing confidential material that you don't want coming out of a shared network printer; your computer could be a long walk from the shared printer; or you may simply be working in a home office. The LaserJet 4L's two weak points, speed and expansion capability, aren't usually issues for personal printers, and you'll probably find 4 ppm more than adequate.

Most important, the 4L and the 4ML give you the same quality as big, expensive

models without taking up your entire desk and a big chunk of your cash. Forget what you learned growing up—if you buy a 4L, don't share it. Keep it all for yourself.

For More Information

HP LaserJet 4L, \$849 HP LaserJet 4ML, \$1279 Hewlett-Packard Co.

P.O. Box 58059/ MS 511L-SJ Santa Clara, CA 95051 (800) 752-0900 fax: (208) 344-4809 Circle 1224 on Inquiry Card.

Howard Eglowstein is a testing editor for the BYTE Lab. You can contact him on BIX as "heglowstein."



BASIC for the Rest of Us

Zedcor's FutureBasic is a powerful (but simple) Mac development tool

TOM THOMPSON

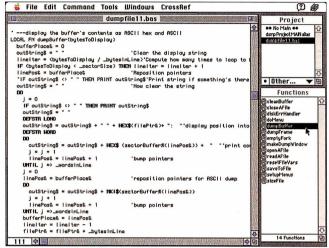
ll vou MacFolk bear with me while I speak heresy. Despite the Mac's many strengths, it's sorely lacking in good, easy-to-use development tools. Sure, there's Symantec's Think C and Think Pascal compilers. However, both C and Pascal have steep learning curves, and neither language is suitable for rapidly knocking out a quick fix. Regrettably, the Mac lacks a decent BASIC compiler. The BASIC language is easy to learn, yet powerful enough to tackle many problems. I've watched many troubles put to rest in the BYTE Lab by quick hacks whipped out in BASIC on PCs, and I've wished that the Mac was capable of the same feat.

Zedcor's FutureBasic promises to change all this. The package costs \$299.95, runs on any Mac, and requires only 2 MB of RAM. It has an integrated development environment that's similar to that of the

Think products: You write code in a program editor, interactively compile, link, and launch the application, and land back in the program editor when the application quits. The result is a quality stand-alone application, with its own resources for menus, icons, and windows.

FutureBasic has many of the familiar BASIC keywords, such as DIM, DO, FOR, AND, OPEN, READ#, WRITE#,

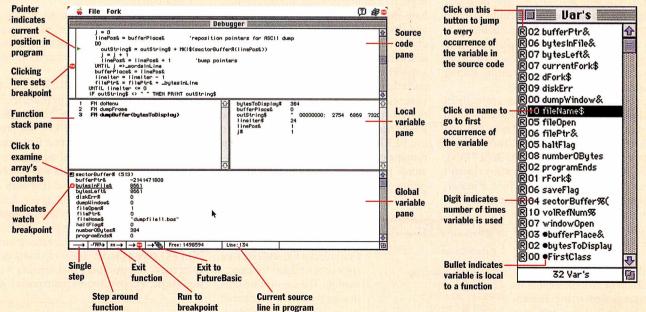
PRINT USING, LEFT\$, MID\$, and RIGHT\$. Where it makes sense, these differ from BASIC keywords from other environments. For example, the OPEN key-



FutureBasic provides a simple BASIC for knocking out real Mac applications quickly. The development environment is like that of Symantec's Think languages.

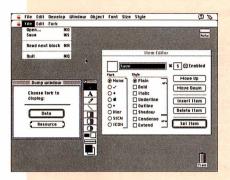
word opens a file's resource fork or data fork. FutureBasic also provides some special Mac-specific keywords, such as HANDLEEVENTS, MENU, DIALOG,

Debugger and Cross Reference Tools



FutureBasic offers a number of plug-in modules called *tools*. You launch them from a Tools menu; each provides FutureBasic with additional capabilities. Keystrokes, mouse-clicks, and other events pass first to active tools, which can act on them or pass them on to the development environment. Of the tools provided with FutureBasic, the Debugger and Cross Reference tools shown here are the most useful.

PG:PRO Application Generator



If you wish the Mac had a good Visual Basic to handle messy interface details, Staz Software has a tool for you. PG:PRO is a program generator that lets you sketch out your interface of menus, windows, and controls on-screen. When you save the completed design, PG:PRO creates both a resource file and FutureBasic files that implement most of the interface operations.

PG:PRO uses a pseudo-object-oriented design to capture events and present them as messages. As an example, there are at least three ways to open a file on the Mac: You can double-click on the file, which launches the application you used to create it; select

Open from an application's File menu and pick a file in the Standard File dialog; or, under System 7, drag and drop a file onto the application's icon. Normally, you have to set up code to field each possibility, but PG:PRO handles all three actions and provides an "open" message with the file's name and volume number.

To test PG:PRO, I reconstructed the file-dump application I'd written with FutureBasic. It was easy to design the interface, since the program's earlier incarnation gave me a good idea of what to do. I then inserted code from the older program into appropriate locations in the FutureBasic files made by PG:PRO. Sure enough, when I dragged a file to the resulting applica-

tion, it opened the file and dumped its contents to the screen. (I had to change the application's FREF resource and rebuild the Desktop file for the Finder to allow this operation, but this is an OS detail, not a problem with PG:PRO.) It took only a few hours to rebuild the application using PG:PRO, but remember that I wasn't starting from scratch.

All in all, PG:PRO makes a great partner for FutureBasic and makes it easy to design applications quickly without getting mired in the details of managing the interface.

About the Product

PG:PRO\$169

Staz Software 11A Leisure Time Dr. Diamondhead, MS 39525 (601) 255-7085 fax: (601) 255-7086

Circle 1226 on Inquiry Card.

SOUND, and WINDOW, that help you implement a rudimentary event loop, build menus, play sounds, and create dialog boxes and windows. An ON TIMER keyword lets you specify code that you want to run periodically—handy for creating timing routines or background tasks.

For us rocket scientists, there's direct access to all the Mac Toolbox calls from within the BASIC environment: You use FN (function) when using a Toolbox trap that returns a value (e.g., FN BUTTON), or CALL for a Toolbox trap that doesn't (e.g., CALL TEXTFONT(4)). Finally, FutureBasic supports the use of in-line as-

sembly language code for those who need the ultimate in fine control.

The BASIC language uses a dollar-sign suffix on a variable name to indicate that its contents are a string. Future-Basic uses other suffixes (e.g., filePointer& or numberOBytes%) to set variable sizes and types. It

supports variable types of integer (16-bit), long integer, BCD (binary-coded decimal), and floating-point (single- or double-precision). There's no ready access to byte-size variables, and for a good reason: Such support might let you unwittingly write code that would generate an odd-address exception on 68000-based Macs. However, if you must deal with data at the byte level (perhaps within a buffer), there are the PEEK and POKE keywords. When running on 68000-based Macs, these keywords perform the required odd-address sanity checks.

Try Out

To evaluate FutureBasic, I wrote a program that lets you first select a file and one fork (resource or data) for examination. The application then dumps the fork's contents to a window as both hexadecimal and ASCII data. I was able to code all the menu choices, window display,

and file I/O using FutureBasic and Mac-specific FutureBasic keywords. Although the manuals provide copious sample code for various programs, a Control Panel, a Desk Accessory, an Apple Event handler, and even an Extension, I was never clear on how to properly write a dialog handler for HANDLEEVENT. Instead, I created my own dialog window in ResEdit, used RESOURCES to load the resource file, and used Toolbox traps to manage the dialog.

FutureBasic 1.01 has two faults—one minor, one serious. When you test-launch your application, it doesn't prompt you to save any changes you made to a file, as the Think compilers do. If the application blows up in your face, you stand to lose any changes you made to your code (maybe that's not such a bad idea after all). The big problem is that FutureBasic needs to handle low-memory situations gracefully. If memory runs low when working with large projects (common when working with PG:PRO), FutureBasic quits unexpectedly or crashes without warning. The only workaround is to give FutureBasic as much memory as you can spare.

Once completed, my code ran reliably, and both disk I/O and window drawing were snappy. I wrote most of the display code quickly, but—as usual—it took me several days to get the error handling and the interface to work properly.

While FutureBasic has flaws that need correcting, it's such a big improvement for BASIC programming on the Mac that I have to admit I like it. Zedcor has provided a powerful compiler that lets more people program the Mac. But the price is a tad steep: I would much rather see it at the introductory price of \$149 it had only a month ago. I'd like to ultimately see Zedcor and Staz merge compiler and application generator into a single product. But even as separate tools, FutureBasic and PG:PRO give Mac developers a strong development environment that mirrors Visual Basic. PC developers, take notice.

Tom Thompson is a BYTE senior technical editor at large and a certified Apple developer. You can reach him on BIX as "tom_thompson" or on the Internet at tomt@bytepb.byte.com.

About the Product

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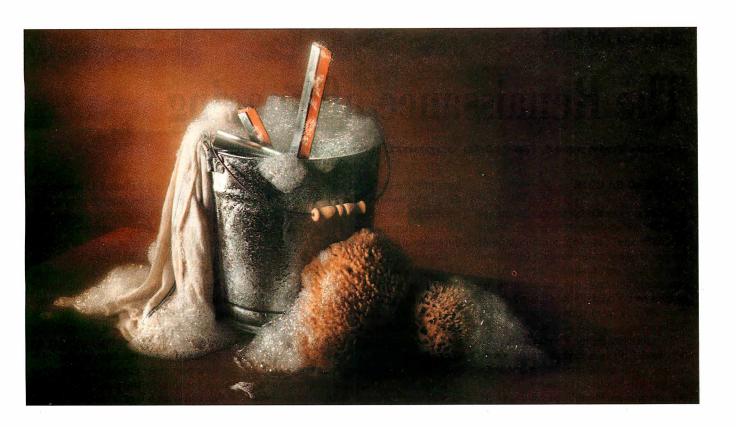
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The Renaissance of Imaging

Kodak releases flagship support products for Photo CD

RAYMOND GA CÔTÉ

astman Kodak intends to change the way graphics professionals handle photographic computer images. Instead of developing traditional photographs and scanning them into the computer, you can have the pictures delivered on a Kodak Photo CD and access them directly from your computer's CD-ROM drive.

To capitalize on the Photo CD revolution, Kodak plans an extensive line of supporting software to retrieve, manipulate, and publish Photo CD images. The first two entrants are PhotoEdge, an image editor running on the Windows and Macintosh platforms, and Renaissance, a publishing tool for the Mac.

The Edge

512 X 768

PhotoEdge (\$135) is a basic image editor that works with Photo CD, TIFF, and Macintosh PICT files. Both the product and the documentation are well designed and intuitive. Although you can manipulate several different image formats, PhotoEdge works best with Photo CD files. Photo CD-specific enhancements include the ability to read in a contact sheet that shows the contents of an entire Photo CD (see the screen below) and automatically displays images in any one of five resolutions. The contact sheet can display im-

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Full Color

Contact Sheet for PCD8463

IMG0019,PCD:1 - 100°

1200 KB

ages in three different sizes and lets you define the number of columns to be displayed. These options allow you to view the maximum number of images, depending on your display monitor.

Once loaded, images can be adjusted for brightness, contrast, and color balance using a pair of scroll bars in a floating window. Changes can be previewed before you commit to the new values. PhotoEdge supports a fairly standard set of image filters. These include a smoothing filter to average the values of adjacent pixels, a sharpening filter to improve contrast, an edge filter to produce outlines, and an inversion filter to create a negative image.

I was surprised to find the image-cropping tool given such prominence in Photo-Edge. Each image window prominently displays the crop-tool button along with the current cropping dimensions. Usually, the crop operation is kept on a menu or toolbar along with other manipulation functions. However, after just a few hours, I was reminded that in a production environment, I perform cropping much more frequently than any other manipulation. You can achieve a fine level of control by dragging a rough crop outline around an object of interest and then performing minor adjustments using a combination of mouse movements and directly entered

Various image conversions are also

1

contact sheet displays the contents of an entire Photo CD and automatically shows images in any one of five resolutions.

A PhotoEdge

available. Full-color Photo CD images can be converted to 256 colors or gray scales, 16 different colors or gray scales, and monochrome. The monochrome conversion offers 18 halftone patterns used to simulate shades of gray on a black-andwhite display.

Unless you are a professional user of halftones, you will find this wide selection to be rather bewildering. The documentation doesn't provide any guidance as to when particular halftone patterns are most useful. You'll need to experiment to see how particular patterns look on your printer for specific images.

You can store images in several file formats including EPSF (Encapsulated Post-Script File), TIFF, and Macintosh PICT. Unfortunately, you cannot read the EPS files back into PhotoEdge. Surprisingly, the popular GIF file format is not supported.

PhotoEdge is a good base-level imagemanipulation program. The reasonable price, intuitive interface, and well-written documentation make PhotoEdge an excellent choice for a first imaging package and a real asset to Photo CD acceptance.

The Renaissance

When I first looked at Renaissance (\$695), I was positive that this was what the world surely does not need—another page-layout program. But, in this case, first looks are definitely deceiving. Renaissance allows you to do page design rather than page layout.

In Renaissance, the focus is on images and graphics rather than text. The program is suitable for designing advertisements, brochures, and probably even small newsletters with a heavy graphical content. Like page-layout programs, Renaissance allows you to define page dimensions, two-page spreads, multiple horizontal and vertical columns, and positions for registration marks. You can also define text boxes and link them together to produce automatic text flow from one box to the next. But that's where the similarity to page-layout programs ends.

The screen on page 147 shows a brochure cover I put together in about 5 minutes to highlight several Renaissance features. The graduated background is one of several stock patterns that can be stretched to any arbitrary size. Objects, such as the drawn circle, all have borders with definable sizes and colors. Images can be pasted into arbitrary shapes (including text) and automatically cropped to the image dimensions.

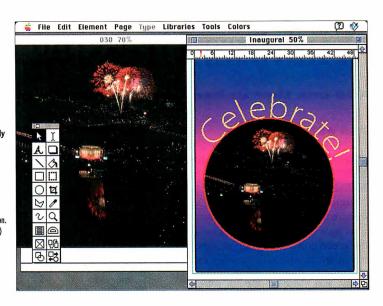
I simply dropped the photo shown here into the circle and then positioned it for best viewing. I then entered the "Celebrate!" text on the page and joined it to the circle. Renaissance automatically joined the text baseline to the graphic outline and positioned the text. I then dragged the text to the proper position at the top of the circle and stretched it out slightly. Instant brochure. You can store frequently used graphical elements in a series of online libraries. These libraries include text styles, text, page definitions, graphical elements, color palettes, and printer setups. For example, if a client insists that his or her brochures use a specific color scheme, you can build a color palette displaying only the appropriate colors.

The manner in which images can be moved around the page is something else that sets Renaissance apart from standard page-layout programs. Grouped graphical elements can show six different behaviors when the group is resized. The default behavior stretches all the elements both horizontally and vertically. You can also elect to stretch each element equally and not change the distance between elements. When resizing a group, you may not want to change the element size but rather just the space between elements. The "move proportionally" option changes the space between elements without changing the element sizes.

You can set each of these options for individual elements and designate different settings for behavior when stretched horizontally and vertically. Renaissance is intelligent about stretching graphical objects such as rules and borders. The weight of a stretched rule will change, but not the border around a box. Borders are controlled separately.

When Renaissance is installed, it also installs a copy of the Pantone Professional Color Matching software. This software lets you correctly select industry-standard Pantone colors on your printouts. Renaissance provides sophisticated control over printed output. If you have a color printer, particularly one that is certified to match the Pantone Color Matching software, you can just print your finished work. Most people, however, need to create color separations for a printing process. Renais-

Renaissance objects, such as this circle, have borders with definable sizes and colors. Images can be pasted into arbitrary shapes (including text) and automatically cropped to the image dimensions. (Photo by Richard W. Strauss, from the Smithsonian Institution's Photographic Collection. Used with permission.)



sance provides a fine level of control over color-separation definitions, even allowing you to define which colors will overprint others. Separated output can be sent directly to a laser printer or to EPS files for transmission to a service bureau for processing.

For your final design, text elements are as important as graphical ones. Renaissance provides a rich set of text-display and -manipulation capabilities, some of which will be familiar to those involved in typesetting. Along with standard functionality such as setting font style, tabs, and indents, Renaissance allows you to fully control kerning, letter and word spacing, leading, and drop caps. A set of special icons let you insert left, right, and center commands to override the defaults for the paragraph (typesetters will feel comfortable with the names Quad left, Quad right, and Quad center). You can also insert variously sized spaces—such as em, en, thin, and figure—and define discretionary hyphens.

Automatic hyphenation uses a rulebased algorithm or a dictionary lookup. You can also apply a combination of the two, using the rules as the default and plac-

ing the difficult-to-hyphenate exception in a lookup table. The lack of an on-line spelling checker is disconcerting; there is nothing quite as distressing as spending days on a layout only to find a misspelled word in the final copy.

Renaissance is a flexible, high-powered page-design package that I found to be very easy to use. It is ideal for graphics-intensive page-layout tasks such as advertisements, brochures, and newsletters.

Resource Hungry

Both these products will happily swallow all the processor power and memory you can provide and come back looking for more. PhotoEdge, a relatively small (480-KB) application, can require around 30 MB of memory when manipulating the largest images (2048 by 3072 pixels in full color). Renaissance has similar resource demands, particularly when you are designing pages with multiple photos and text tied to complicated graphical objects. While reviewing these two products on a Mac IIci, I frequently had time to grab a cup of coffee while waiting for an image to load. Small images load quickly, but if you plan to do professional-level work, you'll want a fast system and a big hard drive.

Kodak PhotoEdge and Kodak Renaissance run the range from entry-level to professional-quality tool. They demonstrate that Kodak is seriously attempting to address image-processing needs at all levels. PhotoEdge is an excellent choice for

casual image manipulation. I recommend Renaissance for anyone needing to create small multipage graphical documents.

For More Information

Kodak PhotoEdge...... \$135

Kodak Renaissance.. \$695

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Raymond GA Côté is a software development engineer for Appropriate Solutions. He also edits Robot Explorer newsletter. You can contact him on BIX as "rgacote" or on the Internet at rgacote@world.std.com.

Reviews Software Roundup

Windows Dressing

Add-ons that enhance, streamline, and simplify Windows

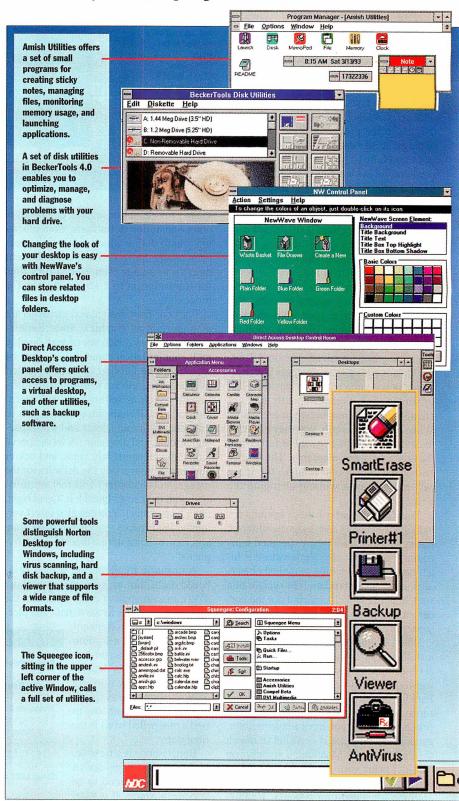
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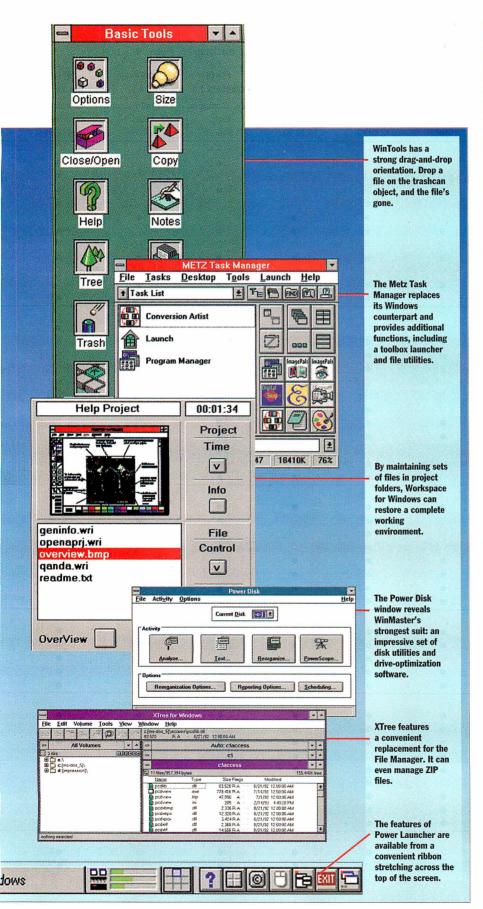
veryone has a unique method for organizing applications and files under Windows. Even if you run a common set of programs (e.g., a word processor, spreadsheet, and communications package), you've probably changed the screen colors, program groups, icons, and other elements to modify the Windows desktop environment to suit your own style.

In this review, I look at 12 packages that customize and enhance your Windows desktop. These packages help you launch programs, manage files, organize your work flow, and personalize the appearance of your Windows desktop. No two do the same job in the same way. Some utilities can replace the Windows desktop with a different metaphor for organizing your working environment. Other packages have a smaller list of features and concentrate on improving or enhancing the built-in Windows program and file management tools.

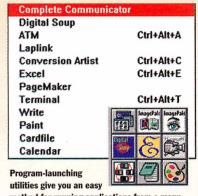
Since each of these packages takes a unique approach to common features, a head-to-head comparison is difficult. Instead, I'll explain some of the features common to all the packages and discuss outstanding software in more detail. Some of the common features in each package are only components of larger Windows utility bundles. Take a close look at the table "Features of Windows Accessories" to see exactly what components each package includes.

Here I'll focus on attributes like program launching and virtual-desktop capabilities, but there are other useful utilities such as file managers, file and text finders, and system-resource displays. In selecting any package, look at the range of features to determine the best mix of utilities for your needs. Remember, though, that an appropriate selection involves more than a simple feature comparison. Because these packages can change the look and feel of Windows, you must make a basic decision. Do you want to overhaul the Windows interface and impose a more structured working environment, or would you rather stick with the basic operation of the Program Manager?





Program Launchers



method for running applications from a menu or toolbar. All the packages I've reviewed here function as launchers. They all provide convenient commands for finding and launching applications under Windows.

Some of these launchers are quite sophisticated and offer a boggling array of features. You can use a configurable toolbar that will launch any application with a mouse-click, and you can configure toolbars to automatically load with each of your applications.

Each accessory package takes a slightly different approach to launching applications. All the packages reviewed are add-ins that leave the Program Manager as the primary shell. Some launchers, such as Hewlett-Packard's NewWave 4.1 and Symantec's Norton Desktop for Windows 2.0, give you the option of replacing the Program Manager entirely.

Launchers come in two flavors: a pull-down list or a toolbar filled with icons. The most flexible list launchers, such as hDC's Power Launcher 2.0 and Icom Simulations' Squeegee for Windows, position icons on the title bar of the active window. You click on the icons to launch programs or access drop-down menus for further options. With both the launch lists and toolbar packages, you can also define the type of files that are associated with applications (e.g., text files with word processors and graphics files with graphics editors). You can then click on a document icon to run the associated program.

Toolbar or toolbox launchers provide a collection of icons corresponding to those in the Program Manager groups. You can position the toolbar anywhere within the screen area. The toolbars offer the advantage of high visibility with easily recognized icons. The disadvantage is that the toolbar takes up room on your computer's screen. Some toolbars, such as hDC's Power Launcher and Task Manager 2.01

Reviews Windows Dressing

FEATURES OF WINDOWS ACCESSORIES

These tools offer a host of useful functions, from program launching to file recovery to resource tracking. ($\circ = \text{yes}$; $\bullet = \text{no.}$)

NAME	BECKERTOOLS 4.0	AMISH UTILITIES For Windows 2.0	WORKSPACE For Windows 1.0	DIRECT ACCESS DESKTOP	POWER Launcher 2.0	NEWWAVE 4.1	SQUEEGEE FOR WINDOWS
Manufacturer	Abacus Software	Amish Software	Ark Interface	Fifth Generation Systems	hDC Computer Corp.	Hewlett-Packard Co.	Icom Simulations
Price	\$129.95	\$99	\$149	\$129	\$99.95	\$195	\$79.95
Desktop features							
Load as Program Manager shell	0	0	0	0	•	0	•
Install user applications as icons	0	0	0	0	0	0	•
Display files as icons	•	•	0	0	e in the second	0	•
Drag and drop icons	•	0	•	0	0	0	•
Configurable menus	•	0	•	•	0	•	. 0
Password security		•	•	•	•	0	•
Link files and applications	0	0	0	0	0	0	0
Link sounds and applications	•	•	•	•	•	•	•
Launch applications	0	0	0	0	0	0	0
Task switching	•	•	•	0	•	•	0
Virtual desktop	•	Ó	•	0	0	•	•
File management features						0 22	
Drag and drop files onto desktop	0	0	0	0	0	0	•
Drag and drop files onto applicati			•	0	•	0	
Manage program groups	0	•		0	•	•	0
Filename limit (characters)	8	8		8	8	32	8
File viewer	0	0	0		•	•	•
File formats supported	9	9	Icons	ASCII	ASCII	ASCII	ASCII
File finder	0	0	•	0	•	0	0
Text finder	0			0		0	0
File archive/compression	0	•		•		•	
Rename files/directories	0 100	0	0	0			0
	Text and Hex	Notes editor		0	•		
Directory cut and graft	O	O		•			0
Drive management							
Optimize drive	0	_	_	_	_		_
Tree and file list	0	0		0			File list
	0	0		0			File list
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Back up to floppy disks	0	•	•	0	•	•	•
Data recovery				810	9		
Disk diagnosis	0			• Annual Market and Annual Ann		•	•
File undelete	0	•	•	•	•	•	•
Trashcan	•	0		0	0	O	
File shredder	Line of the state	•				•	
Virus scanning	•	•	•	0	•	•	•
Accessories							
Calculators	•	•	•	•	•	•	•
Screen saver	0	•	•	•	0	•	•
lcon editor/library	0	•	•	•	•	•	•
Customize tool icons	0	•	0	•	0	•	•
System information	0	•		•	0	•	•
Resource information	0	0	•	•	•	•	0
Batch commands	•	•	•	•	0	•	•
Macro commands	•	•	•	•	0	0	•
Scheduled macro commands	•	•	•	•	0	0	•
Network compatibility							
Use across network	•	0	•	•	•	. 0	•
Share files across a network	•	0	0	•	•	0	•
AND THE RESIDENCE OF THE PROPERTY OF THE PROPE	The state of the s			THE RESERVE TO STREET	A WINDSHIP OF THE PROPERTY OF THE PARTY OF T		

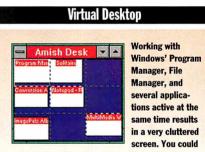
TASK MANAGER 2.01	WINMASTER 1.5	NORTON DESKTOP FOR WINDOWS 2.0	WINTOOLS 1.0A	XTREE For Window
Metz Software	PC-Kwik Corp.	Symantec Corp.	Tool Technology Publishing	XTree Co.
\$49.95	\$129.95	\$149	\$149	\$99
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from Metz Software, can be closed or made invisible after a program launch.

Choosing the best program launcher depends on your preference for lists or toolbars. I prefer the list launchers, because they use less screen space. Most of my work involves word processing, so I prefer to see as much text as possible without any extraneous clutter. Other users might prefer a floating toolbar that offers quick access to their favorite applications and macros.

The Power Launcher offers both lists and toolbars. It has a wide range of features and an extensive set of customizing options, such as associating and launching custom toolbars for popular Windows applications. I also liked the position of the toolbar at the top of the screen, and the Power Launcher's custom menus are easy to configure. It even gives you the option to launch multiple applications with one mouse-click.

I liked one other launcher almost as well. The Task Manager employs a customizable toolbox interface. It replaces the Windows Task Manager with an enhanced module that includes file management, searching capabilities, and file launching.



solve that problem by getting a larger display monitor, or you could use a virtual desktop.

A virtual desktop consists of several miniature screens grouped together in a grid. Each screen has its own set of icons and application windows. Each of these miniature screens is a desktop that contains a set of applications. The virtual screen in the upper left corner of the grid might contain Microsoft Word; next to that might be a screen with the Program Manager and File Manager; and another screen could contain a DOS application, such as a communications program or database. You can move through the set of virtual desktops by clicking within the selection grid. When you select the screen, the selected desktop zooms out to fill the screen.

The virtual desktop lets you easily switch between applications. You can also

Reviews Windows Dressing

automatically load a predefined application set. Most utility packages, including the Power Launcher, Amish Utilities for Windows 2.0, and WinTools 1.0a, will allow you to specify a position on the virtual desktop screen for each application. You can also rearrange the position of the virtual screens within the selection grid.

The Power Launcher has one of the best virtual desktops. You can have up to 64 virtual screens, even though using more than the default value of nine screens is overkill. You can make the Power Launcher virtual desktop invisible while you're working, or the grid of virtual desktops can stay in front of the active window, ready for fast access. I also liked Win-Tools' virtual desktop. WinTools lets you designate tools and icons that will "follow" you around as you switch among the virtual screens. A tagged application will automatically move to the active virtual screen. For instance, you might have an icon that notifies you of incoming E-mail or fax receipts. By tagging the icon, it will always remain visible so that you won't miss a notification.

Visual Metaphor



The method used to organize your work in Windows is called a visual metaphor. An onscreen image represents a function, a program, or a file. By manipulating a familiar image, you perform a function such as copying or moving files. Ark's Workspace for Windows is shown here.

Ark Interface's Workspace for Windows 1.0 has taken the desktop visual metaphor to its logical conclusion. Workspace adopts the image of a well-equipped office, where your documents are organized in binders and filing cabinets. All your programs are represented by familiar objects. For ex-

ample, a paintbrush represents the Windows Paint program, a desktop telephone might hold a communications program, and a pencil could call Windows Write. Every object can also carry a text label. Clicking on an object fires up the associated program.

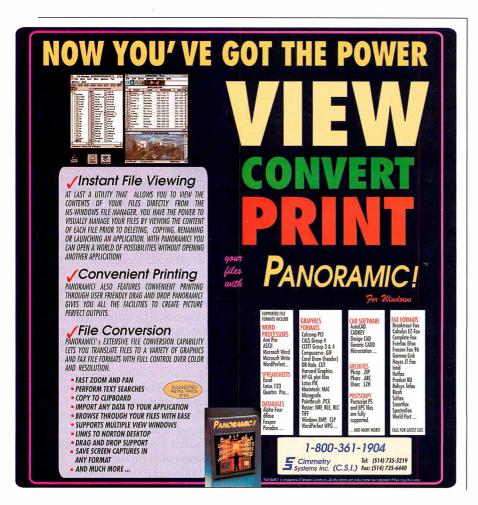
All these objects are located on what appears to be an office desktop. You can associate any of the 24 built-in objects with any program. You can arrange the objects on the desktop or in the office as you like. Workspace gives you the visual equivalent of an office equipped with familiar accessories, so you can work on the computer much as you would in reality.

Workspace manages your files by organizing them in up to nine project binders. Each of these virtual binders is associated with its own subdirectory on the hard drive. When you start a new project, Workspace creates a subdirectory where it automatically stores and tracks all the files you create as you work on the project. You can view and launch all the files in a binder using an OverView Window. In this window, each file in the project binder is represented by a small "snapshot" of the actual file. By clicking on a snapshot, you load the target file into the application that created it.

Workspace can recall an entire working environment, opening applications and restoring files to the state where you last left them. For example, if you were working on the third page of a document and updating a spreadsheet graph, Workspace can save the environment, and, when you open the project again, the word processing program will display the third page of your document and the spreadsheet will load up the graphing module. Unfortunately, you are limited to working on one project at a time.

You can keep track of the time you spend on each Workspace project and review or print out the tracking data for any day, week, or month. You have immediate access to the time information and can create a report to build invoices or to evaluate your productivity.

HP's NewWave also takes a project orientation. NewWave replaces the Windows interface with an object-oriented system. It uses file drawers, folders, file icons with 32-character labels, and a wastebasket as GUI elements. Files and applications are objects. These objects can be stored on the desktop or in folders, copied or shared, or dropped in the trash. NewWave has a vaguely Mac-like look but not the ease of use of the Mac OS. The Mac integrates



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Reviews Windows Dressing

the operating system and the user interface to a greater degree. And, while all Mac applications share a common user interface, NewWave has to contend with a wide variety of Windows applications, each with its own unique interface.

File Management



File management is a critical component of Windows accessories. You need to know what files you have, where your files are, how to get them, and how to keep them intact. One of the major complaints about Windows has always been the File Manager. Although the File Manager has improved with each Windows update, it is still somewhat clumsy and inadequate. The utilities covered here include all the basic functions of the File Manager while adding important features—such as file viewing—that the File Manager lacks.

I appreciate Norton Desktop for Windows because I know that no matter what happens, I can always find, copy, back up, or recover my files. The Norton Desktop is not extraordinary in appearance. The Desktop displays the drive icons on the right, with a toolbar on the left. Clicking on any drive icon brings up the Norton File Manager window. Similar to the Windows File Manager, the Norton File Manager includes a set of buttons to let you move, copy, delete, sort, and filter elements in the file display. You can drag and drop files from one drive window to another or onto the printer icon on the toolbar.

Norton Desktop presents you with a user interface that is better than Windows' but not as unusual as that of NewWave or Workspace for Windows. Norton's Quick Access module looks and works like the Windows Program Manager; however, it provides password protection to selected files within groups. You can also position groups and icons directly on the desktop, and you have the option to display groups in normal mode, in a list, or in a toolbox. Another popular feature allows you to browse through word processing, spreadsheet, database, and graphics files in 45

Norton Desktop is configured for use across a network, and the latest version includes support for Microsoft's Windows for Workgroups, allowing you to send mail or files to other WFW users. You can purchase a Network Menuing Administration Pack to simplify setup and maintenance. The administration module lets you standardize the look of the Norton Desktop across a network and control access to applications and files.

With so many features and accessories, there is no doubt that Norton Desktop for Windows is the best of the file and hard disk management accessory packages. The sheer volume of its features takes it beyond a collection of accessories and turns it into an excellent working environment. Of the packages reviewed, the only other one that comes close is BeckerTools 4.0. It has a similar set of utilities, but it lacks the network support. I took the file management component from BeckerTools and used it to replace the Windows File Manager. I then had a more functional file manager without having to overhaul my Windows environment. BeckerTools has a convenient toolbar in its file management shell for one-click deleting, searching, viewing, printing, editing, or executing files.

Choosing a Set of Utilities

After working with all these packages, I naturally developed a few favorites. Unfortunately, few of these Windows utility compilations offer the best of every feature. The Power Launcher has the best program launcher; NewWave offers the most comfortable desktop metaphor. I was intrigued with the Workspace for Windows environment, but it's a little too cute to work with on a daily basis.

It's too bad you can't buy just the desktop metaphor from NewWave, or the virtual desktop from Amish Utilities. As a complete package, I like Norton Desktop for Windows best. It's not the best in every category, but the desktop organization is very strong and the package includes all the Windows tools you'll ever need. ■

Stan Wszola is a testing editor for the BYTE Lab. You can reach him on BIX as "stan."

Company Information

Abacus Software, Inc.

(BeckerTools 4.0) 5370 52nd St. SE Grand Rapids, MI 49512 (800) 451-4319 (616) 698-0330 fax: (616) 698-0325 Circle 1230 on Inquiry Card.

Amish Software, Inc.

(Amish Utilities for Windows 2.0) 541 Cowper St., Suite A Palo Alto, CA 94301 (415) 323-4627 fax: (415) 323-0138 Circle 1231 on Inquiry Card.

Ark Interface, Inc.

(Workspace for Windows 1.0) 1201 Third Ave., Suite 2380 Seattle, WA 98101 (800) 275-3698 (206) 654-4127 fax: (206) 654-4188 Circle 1232 on Inquiry Card.

Fifth Generation Systems, Inc.

(Direct Access Desktop) 10049 North Reiger Rd. Baton Rouge, LA 70809 (504) 291-7221

Circle 1233 on Inquiry Card.

hDC Computer Corp.

(Power Launcher 2.0) 6742 185th Ave. NE Redmond, WA 98052 (206) 885-5550

Circle 1234 on Inquiry Card.

Hewlett-Packard Co. (NewWave 4.1) 974 East Argues Ave. Sunnyvale, CA 94086 (800) 554-1305 (408) 720-3441 fax: (408) 720-3560 Circle 1235 on Inquiry Card.

Icom Simulations, Inc.

(Squeegee for Windows) 648 South Wheeling Rd. Wheeling, IL 60090 (708) 520-4440

Circle 1236 on Inquiry Card.

Metz Software, Inc.

(Task Manager 2.01) P.O. Box 6699 Bellevue, WA 98008 (206) 641-4525 fax: (206) 644-6026 Circle 1237 on Inquiry Card.

PC-Kwik Corp.

(WinMaster 1.5) 15100 Southwest Koll Pkwy. Beaverton, OR 97006 (503) 644-5644 fax: (503) 646-8267 Circle 1238 on Inquiry Card.

Symantec Corp.

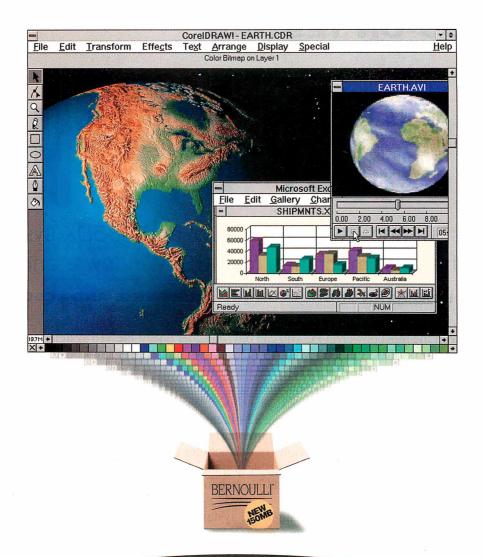
(Norton Desktop for Windows 2.0)10201 Torre Ave. Cupertino, CA 95014 (408) 253-9600 fax: (408) 253-4092 Circle 1239 on Inquiry Card.

Tool Technology Publishing

(WinTools 1.0a) 1125 A St., Suite 107 San Rafael, CA 94901 (415) 459-3700 Circle 1240 on Inquiry Card.

XTree Co.

(XTree for Windows) 4115 Broad St., Building 1 San Luis Obispo, CA 93401 (800) 876-6368 (805) 541-0604 fax: (805) 541-8053 Circle 1241 on Inquiry Card.



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HANDS-ON TESTING

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RICHARD FOX, ALAN JOCH, LEONARD PRESBERG, AND LESLIE REISZ

f you need the most powerful PC you can buy, consider one of the 116 systems tested here. These 50-and 66-MHz 486DX2s and 50-MHz 486DXs allow you to run today's business and scientific applications efficiently. What's more, these systems are a hedge against obsolescence: Even in light of Intel's recent Pentium announcement, high-end 486s should remain the processors of choice for most single-user workstations well into next year. And if Windows NT, OS/2, or Unix is in your future plans, these 486s can adequately handle those 32-bit environments.

We chose winners and runners-up that are particularly suited to important applications under DOS, Windows, and Unix. The list at the far right shows our choices for the best systems. In subsequent pages, we recommend the best 486s that are highly expandable and those that are inexpensive. We also evaluate the various graphics chip sets, disk caches, and local-bus schemes these systems use and show how these design choices relate to system performance.

We found that the local bus has taken high-end systems by storm. We ranked a total of 29 systems as winners or runners-up, and only five—from Computer Sales, Hertz, Swan, Micro Express, and Unisys—didn't use a local bus to speed the graphics subsystem. All the ranked local-bus systems used the VESA implementation, the VL-Bus, except for those from Dell and NEC, which used proprietary schemes.

The graphics-accelerator choices by systems vendors also proved to be significant. Of the top 15 performers in our graphics tests, 13 used the Weitek Power 9000 (the remainder used the S3-805 accelerator).

Best of all, the marketwide drop in hardware prices over the last 18 months has also touched the high end. Although the most expensive systems we tested sell for \$10,000, we can recommend 10 systems for under \$2700 that performed close to the fastest systems and were built to last.

But not all the trends we found were positive. Quality control is a pervasive problem: 40 out of the 116 systems we received either wouldn't boot on the first try or had some other serious hardware problem.

How to use this guide

To find the best high-end system, follow the main headings until you come to the application category that most closely matches yours. Then look to the Best Overall, Most Expandable, or Low Cost summaries. In all cases, higher index numbers indicate faster performance. Our decision was

based 50 percent on performance, 30 percent on features, and 20 percent on ease of use. Although you can use highend 486s as network servers, this report focuses on their suitability as single-user workstations. The prices we quote are list prices for our as-tested configurations.

Summary boxes detail the best systems for each application category. For each application, we name best overall, most expandable, and best low-cost systems.

Besides the top pick, each summary box gives the vital statistics for other outstanding systems.



| PROCESSOR | CASE PROC. | STATE | SECTION | S

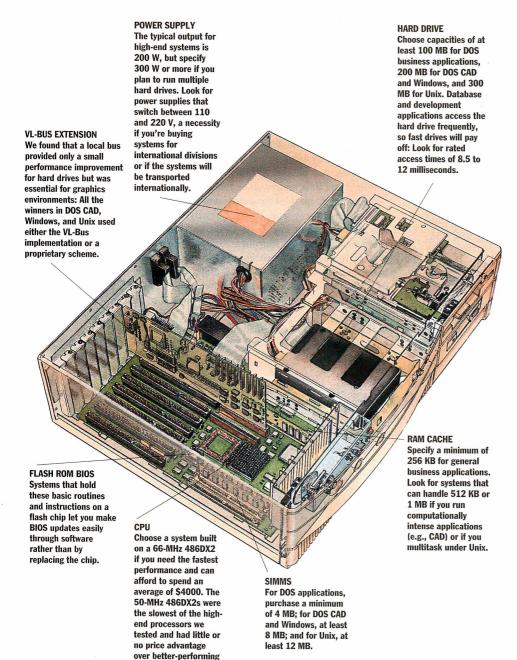
The top system in each group. We point out the qualities that made us choose this system as best for this application.

The deciding factors for this category. Speed-index numbers change from application to application, because we calculate these indexes based on tests most appropriate for the category. For example, the speed index in the database category is most dependent on our database application test.



116 FAST 486S

What to Look For in a High-End System



DOS WORD PROCESSING, DESKTOP PUBLISHING, AND SPREADSHEETS

Xinetron X/LAN 486DX2

This workstation is fast: It turned in outstanding results on our word processing and spreadsheet application tests and also had the fastest storage and graphics subsystem. **PAGE 159**

DOS DATABASE AND DEVELOPMENT

Lightning Thunderbox II

A tower system that captured both Best Overall and Most Expandable honors. The Thunderbox II includes a full megabyte of processor cache, which helped it outperform all other systems in this category. **PAGE 163**

DOS CAD AND GRAPHICS NEC Image 466

NEC's Image 466 uses a proprietary local-bus implementation to boost graphics performance. The system's combination of graphics speed, low cost, and clear, sharp monitor makes it best for CAD and graphic arts. **PAGE 165**

WINDOWS CompuAdd 466 DX2 Desktop Power

VL-Bus graphics, a noninterlaced 1280- by 1024pixel display, and easily accessible memory and adapter slots qualify the CompuAdd 466 DX2 as the best system for Windows. Besides performance features, the 466 DX2 also comes with excellent documentation and strong technical support. PAGE 171

UNIX Hertz 486/66Ei

BYTE Unix tests and SPEC benchmark results both ranked the Hertz 486/66Ei fastest among Unix systems. PAGE 179

50-MHz 486DXs.

SYSTEMS FOR

DOS WORD PROCESSING, DESKTOP PUBLISHING, AND SPREADSHEETS

ven though at first blush a 50- or 66-MHz CPU with an integrated FPU may sound like overkill, we found fast 486s to be excellent choices for DOS word processing, desktop publishing, and spreadsheet applications. This power comes in handy for today's versions of WordPerfect and Lotus 1-2-3, which let you perform demanding tasks like linking data from many spreadsheets, running spreadsheets in 3-D, or working out WYSIWYG previews. The right 486 can ensure that page scrolling, text search and replace, graphing, and computation take place without slowing the pace of your work.

Performance was the key attribute we considered when choosing winners and runners-up in our word processing and spreadsheet application tests. Many word processing and spreadsheet operations are computationally intense—the computer must frequently access the hard drive, and graphics-intensive page scrolling is common—so we looked at an even mix of CPU, memory, hard drive, and graphics subsystem performance. We used BYTE's hardware-component tests to rate the speed of subsystems. Our suite of application tests, which included WordPerfect 5.1 and Lotus 1-2-3 release 2.4, gave us insights into how

each system ran actual business programs. Our performance rankings weighted these subsystem and application tests most heavily (additional subsystem and application tests rounded out our evaluations).

We identified some clear technology trends that explained why the winners and runners-up stood out from the rest of our test sample. All the systems that were rated Best Overall or Low Cost used 66-MHz 486 processors. Of the 12 systems we ranked in the entire business applications group, only the Swan 486/50ES, a Most Expandable runner-up, used a 50-MHz processor. In most cases, the 66-MHz systems performed faster than 50-MHz counterparts and didn't necessarily command a premium price. The Swan system was a notable exception: It recorded the same performance score as the Swan 486/66ES, which was identical except for its 66-MHz processor. The 50-MHz model costs \$100 less, but apparently identical supporting hardware for the 50- and 66-MHz versions make the extra clocks moot. We saw no reason to buy Swan's 66-MHz system over its less expensive cousin.

UNSAFE AT ANY SPEED?

In the relentless quest for more computing power, vendors are always striving for ways to produce the fastest systems. One vendor, Personal Computer Graphics, submitted the Turbo Max 80, a system based on a 66-MHz 486DX2 that PCG says can run internally at 80 MHz.

Our test results showed that the Turbo Max 80 clearly operated at speeds beyond those of most of the other systems in this roundup. It outperformed all the other systems in our three DOS application categories and placed within the top five for the Windows and Unix performance tests.

According to an Intel spokesperson, Intel does not test or guarantee and, consequently, does not condone operating any of its CPUs outside of the rated specifications. Moreover, unless the entire system is designed to withstand the excess heat being generated by the 486DX2 chip, unexpected heat dissipation could lead to system failure. PCG addresses this issue by equipping the Turbo Max 80 with three fans, including one mounted on the CPU. In the end, we decided not to include this system in



PCG Turbo Max 80

our rankings, because of our unanswered questions about its long-term reliability.

In the Best Overall category, the AST Premmia 4/66d Model 343W, the Boss 466EV, and the NEC Image 466 came with 256 KB of secondary cache RAM, which sped up these systems in handling large applications, such as those in our application tests. Secondary cache RAM among slower systems was 128 KB. The Xinetron X/LAN Workstation and the Boss 466EV included 1 MB of hard disk cache; in contrast, many unranked systems came with no disk cache or only a 64-KB track buffer. Finally, among the Best Overall systems, only the Hertz 486/66Ei didn't take advantage of a local-bus graphics accelerator to speed screen redraws. Accordingly, its graphics test results were the slowest of these five systems.

Bus type showed little differentiation in our performance tests: ISA and EISA systems performed comparably, primarily because we tested them as workstations rather than as network servers.

Although performance accounted for half of our selection criteria, we also rated each system by the presence or absence of standard features that would aid DOS users running word processors and spreadsheets. This represented 30 percent of our evaluation.

For example, monitor quality is important for these applications. The best monitors were High Definition's Amax Impression Plus and the unit bundled with the AST Premmia, both of which support noninterlaced resolutions of up to 1280 by 1024 pixels. NEC's Image 466 is available with an NEC 3FGX monitor, another standout for crisp displays.

Keyboard feel is obviously important for word processing applications, but we had two reasons for leaving it out of our numerical rating. First, the suitability of a keyboard is a subjective rating, and our preference for clicky versus mushy or the position of the Escape key in the upper left corner may not match yours. Second, high-end machines such as these are more amenable to page-layout and design tasks and are a bit too expensive for heavy data-entry tasks, where keyboard quality is critical.

Finally, we rated systems for ease of use by considering such factors as the quality of technical manuals and the accessibility of expansion slots and drive bays. Here, specifications were sometimes deceiving. For example, the Acma 486/DX2-66 VESA System, a low-cost runner-up, offered five available ISA slots, but two of them were obstructed by wiring and would accommodate only halflength cards.

As with a number of other systems we tested (see the text box "Poor Quality Control" on page 169), the first X/LAN we received would not boot. Xinetron eventually sent a replacement unit that ran without problems. Even though its performance, ease of use, and features were all high enough to make it a winner in our Best Overall category, we remain disappointed by the lack of quality control made evident by the problem system. In the end, we let the Best Overall designation stand, only because the replacement unit ran without a hitch.

Desktop Tower ☐ Mini-tower VL = VL-Bus

$\mathbf{B}\mathbf{Y}\mathbf{T}\mathbf{E}$ BEST

DOS BUSINESS APPLICATIONS

Running classic DOS applications?

BEST OVERALL

Xinetron X/LAN 486DX2



This 1-foot-tall mini-tower ran our word processing tests faster than any of the runners-up did and scored a virtual tie with the Boss 466EV as the fastest system for the spreadsheet test suite. Its storage subsystem, which is built around a 340-MB Maxtor SCSI drive with 1 MB of cache, was the fastest in this group, as was the

system's VL-Bus graphics system. We found this system easy to live with: We could quickly add expansion cards, thanks to its easy-to-remove case and accessible adapter slots and SIMM slots. The system comes standard with a 36-month warranty and an informative manual.



		PROCESSOR	CASE	PRICE	INDEX	USE OF	ROS	(MAX. RES.)	HARD DRIVE	RAM CAC Standard	
BEST	Xinetron X/LAN 486DX2	486DX2/66		\$2699	7.6	Excellent	VL, ISA	1024 × 768	340-MB SCSI	128	256
RUNNER-UP	AST Premmia 4/66d	486DX2/66		\$5090	6.7	Good	VL, EISA	1280 × 1024	340-MB IDE	256	512
RUNNER-UP	NEC Image 466	486DX2/66		\$3499	6.9	Excellent	ISA'	1024 × 768	340-MB IDE	256	256
RUNNER-UP	Boss 466EV	486DX2/66		\$4495	7.4	Fair	VL, EISA	1024 × 768	340-MB SCSI	256	256
RUNNER-UP	Hertz 486/66Ei	486DX2/66	J.	\$5870	6.2	Excellent	EISA	1024 × 768	1.2-GB SCSI	128	256

Boss 466EV

Need expansion?

MOST EXPANDABLE



The \$4495 Boss 466EV ran almost a dead heat with the Best Overall X/LAN in the word processing and spreadsheet application tests. Among the Most Expandable finalists, the Boss ran the application tests about 20 percent faster than the competition did. In addition to performance, the Boss will meet most expansion needs with one VL-Bus and four EISA slots, a SCSI port, and six 51/4-inch drive bays. One caution: The second of two fans located inside the chassis troubled us. Its tacked-on mounting suggested an additional fan was added to the original system design because of overheating problems; however, we didn't

		PROCESSOR	CASE	PRICE	SPEED Index	EASE OF USE	BUS	DISPLAY (Max. Res.)	HARD DRIVE	DRIVE 3%"	BAYS 5%"
BEST	Boss 466EV	486DX2/66		\$4495	7.4	Fair	VL, EISA	1024 × 768	340-MB SCSI	0	4
RUNNER-UP	Hertz 486/66Ei	486DX2/66	6.	\$5870	6.2	Excellent	EISA	1024 × 768	1.2-GB SCSI	7	2
RUNNER-UP	Swan 486/50ES	486DX/50	1	\$5969	6.0	Excellent	EISA	1024 × 768	325-MB SCSI	7	2
RUNNER-UP	Lightning Thunderbox II	486DX2/66		\$3895	7.8	Fair	VL, EISA	1280 × 1024	520-MB SCSI	0	3
RUNNER-UP	Microtech MT/VLB	486DX2/66		\$3099	7.7	Fair	VL, ISA	1280 × 1024	340-MB IDE	1	5

experience any heating problems during our testing.

Watching the bottom line?

LOW COST

Eastern Tech ET 486VLB66



If performance were our only consideration, the 486VLB66 would have been a Best Overall finalist. We're comfortable in putting it at the top of our low-cost list because the system's speed and \$2595 price compensate for the superficial documentation and the lack of a flash ROM BIOS and a toll-free technical-support line. But it shines in speed: The system ran our word processing and spreadsheet tests faster than any other machine we ranked. The low-level test results showed it was especially fast in the drive tests, which is attributable to the local-bus Tekram hard drive controller with 1 MB of cache (maximum of 16 MB) and the 14-ms, 340-MB Western Digital hard drive. Graphics performance was also outstanding, thanks to a VL-Bus implementation of an S3-805 graphics accelerator.

		PROCESSOR	CASE	PRICE	SPEED Index	EASE OF USE	BUS	DISPLAY (Max. Res.)	HARD DRIVE	TECH. SUPPORT
BEST	Eastern Tech ET 486VLB66	486DX2/66		\$2595	7.9	Fair	VL, ISA	1024 × 768	340-MB IDE	Lifetime
RUNNER-UP	High Definition HDVLB66	486DX2/66		\$2400	6.5	Fair	VL, ISA	1280 × 1024	340-MB SCSI	Lifetime
RUNNER-UP	Acma 486/DX2-66 VESA	486DX2/66		\$2595	7.2	Fair	VL, ISA	1024 × 768	360-MB IDE	12 months
RUNNER-UP	Computer Expo 486VLB/66	486DX2/66		\$2567	6.9	Fair	VL, ISA	1024 × 768	340-MB IDE	36 months

¹ Video is on proprietary local bus.

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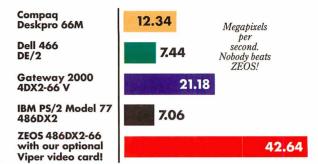
--PC Computing, March 1993, BEST VALUE

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PC MAGAZINE LABS BENCHMARK TESTS: GRAPHICS WINMARK



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—PC Magazine, 1/26/93

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—PC World, February 1993, BEST BUY

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32K 128K 128K 256K Built-in hard drive cache	
Local bus IDE hard drive int	erface
16 16 12 12 Seek time (ms)	
■ 1.2MB Teac floppy drive	
■ 1.44MB Teac floppy drive	
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ZEOS 14" high-resolution 102 non-interlaced SVGA color m	24x768 nonitor
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Flash BIOS	
High-capacity 200W power s and built-in surge suppression	supply 1
ZEOS SpaceSaver case with a drive bays	six
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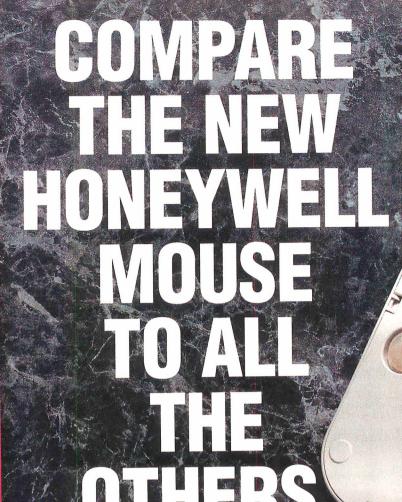
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BYTE BEST

DATABASE AND DEVELOPMENT

Fast performance for database applications hinges on the effective integration of CPU, memory, and hard drive subsystems. The efficiency of the components translates into being able to work rather than wait while your system is executing queries, generating reports, or compiling code.

Performance was our most important selection criterion, and we devised our speed-index number by combining results of application and subsystem tests and giving emphasis to the CPU, memory, hard drive, and FoxPro portions of the two test suites.

The Lightning Thunderbox II, the best system overall, distinguished itself with high scores in our CPU and drive tests. All the Best Overall systems used 66-MHz processors. The AST Premmia, the CompuAdd 466 DX2 Desktop Power, and the Hertz 486/66Ei each posted high marks in the memory subsystem tests. The Thunderbox II and the FutureTech System 462eV showed fast performance on our drive tests, along with solid scores for CPU and memory.

Database users need flexibility for adding memory to boost performance or drives to provide redundant storage. Our Most Expandable rankings show the five standout systems. The Swan 486/50ES deserves mention. Its tower case is one of the most flexible designs we have seen: It has eight free 3½-inch drive bays and six free EISA slots.

The systems in the low-cost category provided 486 power for under \$2600, with the 50-MHz Micro Flex selling for less than \$2000 (we recommend it as only a runner-up because it was the slowest in the group).

KEY

Desktop

■ Tower

Mini-tower

VL = VL-Bus

Want the fastest database machine?

BEST OVERALL

Lightning Thunderbox II



This tower received the highest score among the database and development leaders in our subsystem and application tests. In addition, it sped through the FoxPro 2.0 application test two times faster than its nearest competitor (the FutureTech System 462eV). It includes 1 MB of secondary cache (128 or 256 KB is the norm), a Tekram SCSI hard drive controller with 1 MB of

cache, a 520-MB Maxtor hard drive with a fast (8.5-nanosecond) access time. Rounding out its fine performance, the system comes with a two-year warranty covering parts, labor, and shipping, as well as lifetime technical support with a toll-free support line.



		PROCESSOR	CASE	PRICE		EASE OF USE	BUS	DISPLAY (MAX. RES.)	HARD DRIVE	RAM CAC Standard	HE (KB) Max.
BEST	Lightning Thunderbox II	486DX2/66		\$3895	7.8	Fair	VL, EISA	1280 × 1024	520-MB SCSI	1024	1024
RUNNER-UP	Xinetron X/LAN 486DX2	486DX2/66		\$2699	7.2	Excellent	VL, ISA	1024 × 768	340-MB SCSI	128	256
RUNNER-UP	Hertz 486/66Ei	486DX2/66		\$5870	6.2	Excellent	EISA	1024 × 768	1.2-GB SCSI	128	256
RUNNER-UP	CompuAdd Desktop Power	486DX2/66		\$4039	6.3	Excellent	VL, ISA	1280 × 1024	500 MB IDE	256	256
RUNNER-UP	AST Premmia 4/66d	486DX2/66		\$5090	6.3	Good	VL, EISA	1280 × 1024	340-MB IDE	256	512
RUNNER-UP	FutureTech System 462eV	486DX2/66		\$3129	7.1	Good	VL, EISA	1280 × 1024	340-MB SCSI	256	512
RUNNER-UP	NEC Image 466	486DX2/66		\$3499	6.5	Excellent	ISA ¹	1024 × 768	340-MB IDE	256	256

Planning for expansion?

MOST EXPANDABLE

Lightning Thunderbox II



In addition to its pacesetting performance in our FoxPro and subsystem tests (see item above), the Thunderbox II can easily be expanded in the three areas vital to database and development performance: CPU, memory, and storage. The system contains a socket for upgrading to Pentium processors, disk cache that's expandable to 16 MB, and five available EISA slots.

		PROCESSOR	UASE	PRICE	INDEX	USE	ROZ	(MAX. RES.)	HARD DRIVE		BAYS 5%"
BEST	Lightning Thunderbox II	486DX2/66		\$3895	7.8	Fair	VL, EISA	1280 × 1024	520-MB SCSI	0	3
RUNNER-UP	Hertz 486/66Ei	486DX2/66		\$5870	6.2	Excellent	EISA	1024 × 768	1.2-GB SCSI	7	2
RUNNER-UP	Swan 486/50ES	486DX/50		\$5969	6.1	Excellent	EISA	1024 × 768	325-MB SCSI	8	2 .
RUNNER-UP	Boss 466EV	486DX2/66		\$4495	7.4	Fair	VL, EISA	1024 × 768	340-MB SCSI	0	4
RUNNER-UP	Microtech MT/VLB	486DX2/66		\$3099	7.7	Fair	VL, ISA	1280 × 1024	340-MB IDE	1	5

Need top performance for under \$2600?

LOW COST

Eastern Tech ET 486VLB66



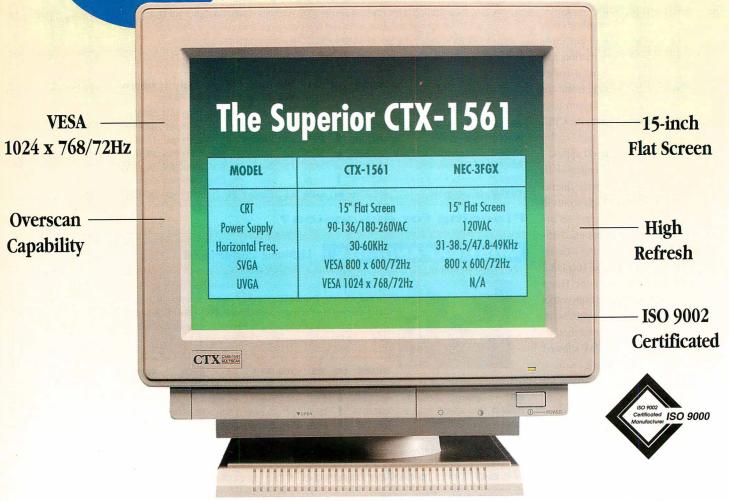
The 486VLB66 came in second to the Thunderbox II as the fastest performer of our database systems and costs \$6000 less than the most expensive system in this applications group—the Swan 486 150ES, which ran the tests considerably slower. The 486VLB66 derives much of its speed advantage from the VL-Bus IDE interface with 1 MB of cache and 256 KB of secondary cache. The 486VLB66 comes with a 24-month warranty covering the system and a 12-month warranty covering the 14-inch 1024- by 768-pixel ViewSonic 6E monitor and the 340-MB Western Digital hard drive.

		PROCESSOR	CASE	PRICE	SPEED INDEX	EASE OF USE	BUS	DISPLAY (MAX. RES.)	HARD DRIVE	TECH. SUPPORT
BEST	Eastern Tech ET 486VLB66	486DX2/66		\$2595	7.4	Fair	VL, ISA	1024 × 768	340-MB IDE	Lifetime
RUNNER-UP	Acma 486/DX2-66 VESA	486DX2/66		\$2595	6.8	Fair	VL, ISA	1024 × 768	360-MB IDE	12 months
RUNNER-UP	High Definition HDVLB66	486DX2/66		\$2400	5.9	Fair	VL, ISA	1280 × 1024	340-MB SCSI	Lifetime
RUNNER-UP	Micro Express Micro Flex	486DX/50		\$1999	5.5	Good	ISA	1024 × 768	325-MB IDE	Lifetime
RUNNER-UP	Acma ISA Workstation	486DX2/50		\$2295	6.3	Good	ISA	1024 × 768	360-MB IDE	12 months
RUNNER-UP	Computer Expo 486VLB/66	486DX2/66	Ī	\$2567	6.5	Fair	VL, ISA	1024 × 768	340-MB IDE	36 months

¹ Video is on proprietary local bus.

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BEST

Fast 486s are the systems of choice for CAD and graphics professionals. The high clock speeds and integrated floating-point processors play well against the complex computations of these applications. And with high-resolution displays the norm for CAD and graphics, local-bus video accelerators mean

faster screen redraws and more

efficient work.

We gave the most emphasis to the results of the Lotus 1-2-3 release 2.4 and Autodesk Animator Pro 1.0 tests, which together challenged each system's computational, floating-point, and graphics capabilities. We gave equal weight to BYTE's subsystem and Windows tests when evaluating performance. We also looked for important CAD and graphics features, such as support for 1280- by 1024-pixel (noninterlaced) displays.

Because of the high computational needs of CAD and graphics, 66-MHz processors dominated our three categories. The only exception was the Keydata Key VL-Bus Windowstation, a 50-MHz 486DX that made runner-up in our low-cost category on the strength of its VL-Bus graphics system.

All the winners and runnersup in this applications group came with some implementation of a local bus. The Best Overall winner, NEC's Image 466, and a runner-up, Dell's 466/ME, used proprietary local-bus implementations; the remaining systems were VL-Bus-based. In the BYTE Windows index, the NEC Image 466 and the Dell 466/ME scored about 10 percent faster than many of their VL-Bus competitors.

KEY■ Desktop ■ Tower □ Mini-tower VL = VL-Bus

CAD AND GRAPHICS

Looking for the best graphics performer?

BEST OVERALL

NEC Image 466



The NEC Image 466 finished a close second to the Boss and X/LAN systems in our performance tests weighted for CAD and graphics, but it achieved top honors on the strength of its entire package. The Image 466's Tseng ET-4000 W32 video accelerator (with 1 MB of DRAM) is integrated on the



motherboard using a proprietary local-bus scheme. Its advantages: Integrated video doesn't occupy a slot, while local-bus video offers fast screen redraws. We found the desktop chassis easy to access for upgrading drives, memory, and boards. The \$3499 price, which was second lowest among the seven Best Overall systems, includes an NEC 3FGX 15-inch monitor—a monitor with outstanding clarity. The price also includes a three-year basic warranty covering parts and labor, lifetime technical support, and a year of free on-site service.

		PROCESSOR	CASE	PRICE		EASE OF USE	BUS	DISPLAY (MAX. RES.)	HARD DRIVE	RAM CACHE Standard	
BEST	NEC Image 466	486DX2/66		\$3499	7.8	Excellent	ISA ¹	1024 × 768	340-MB IDE	256	256
RUNNER-UP	AST Premmia 4/66d	486DX2/66	-	\$5090	7.4	Good	VL, EISA	1280 × 1024	340-MB IDE	256	512
RUNNER-UP	Xinetron X/LAN 486DX2	486DX2/66		\$2699	8.0	Excellent	VL, ISA	1024 × 768	340-MB SCSI	128	256
RUNNER-UP	CompuAdd MC 466EDX2	486DX2/66		\$6884	7.3	Excellent	VL, EISA	1280 × 1024	525-MB SCSI	256	256
RUNNER-UP	Boss 466EV	486DX2/66	I	\$4495	8.0	Fair	VL, EISA	1024 × 768	338-MB SCSI	256	256
RUNNER-UP	Dell 466/ME	486DX2/66		\$3669	7.4	Good	EISA1	1024 × 768	320-MB IDE	128	128
RUNNER-UP	Tri-Star 486 VL Station	486DX2/66		\$3279	7.6	Good	VL, ISA	1280 × 1024	340-MB IDE	256	256

Need a CAD system with room for growth?

MOST EXPANDABLE





The 466EV ran our CAD and graphics tests faster than any other system ranked Most Expandable. The system's 60-ns memory speed and 256-KB 15-ns secondary cache contributed to the strong showing. The 466EV uses a VL-Bus Genoa WindowsVGA 24 video adapter based on a Cirrus Logic chip set; this implementation achieved the highest score in this group for the graphics-intensive BYTE Windows tests. If you need to expand the system to improve performance, the motherboard holds up to 256 MB of memory. The caching drive controller came with 1 MB of cache RAM; the controller can hold a maximum of 16 MB of RAM.

		PROCESSOR	CASE	PRICE	SPEED Index	EASE OF USE	BUS	DISPLAY (Max. Res.)	HARD DRIVE	DRIVE 3%"	BAYS 5%"
BEST	Boss 466EV	486DX2/66		\$4495	8.0	Fair	VL, EISA	1024 × 768	340-MB SCSI	0	4
RUNNER-UP	Hertz 486/66Ei	486DX2/66		\$5870	6.8	Excellent	EISA	1024 × 768	1.2-GB SCSI	7	2
RUNNER-UP	Microtech MT/VLB	486DX2/66	ı	\$3099	7.7	Fair	VL, ISA	1280 × 1024	340-MB IDE	1	5

Cost-conscious?

LOW COST

High Definition HDVLB66



This 66-MHz system finished first in this group thanks to its \$2400 list price, solid performance in our CAD tests, and flexible expansion options. The system offers a local-bus Genoa WindowsVGA 24 video card featuring the Cirrus Logic GD5426 chip set. The HDVLB66 includes 256 KB of secondary cache, 8 MB of RAM, a socket for a P24T processor, and a local-bus UltraStor hard drive controller connected to a 340-MB Fujitsu drive.

		PROCESSOR	CASE	PRICE	SPEED Index	EASE OF USE	BUS	DISPLAY (Max. Res.)	HARD DRIVE	TECH. SUPPORT
BEST	High Definition HDVLB66	486DX2/66		\$2400	7.6	Fair	VL, ISA	1280 × 1024	340-MB SCSI	Lifetime
RUNNER-UP	Eastern Tech ET 486VLB66	486DX2/66		\$2595	8.4	Fair	VL, ISA	1024 × 768	340-MB IDE	Lifetime
RUNNER-UP	Acma 486/DX2-66 VESA	486DX2/66		\$2595	7.7	Fair	VL, ISA	1024 × 768	360-MB IDE	12 months
RUNNER-UP	Key VL-Bus Windowstation	486DX/50		\$2395	7.0	Fair	VL, ISA	1024 × 768	210-MB IDE	Lifetime
RUNNER-UP	CompuEx 486VLB/66	486DX2/66		\$2567	7.6	Fair	VL, ISA	1024 × 768	340-MB IDE	36 months

Video is on proprietary local bus.

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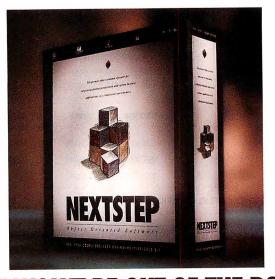
BYTE, OCTOBER 1992

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How We Tested

PERFORMANCE

We tested each system under Windows 3.1, DOS 5.0, and SCO Unix 3.2.4. Our DOS and Windows performance testing consisted of DOS and Windows low-level tests designed by the BYTE Lab and application tests developed by the National Software Testing Laboratories.

The low-level DOS tests determine the quality of computer subsystems by isolating hard drive, memory, and CPU performance. The collection of Windows low-level tests exercises the Windows GDI (Graphical Device Interface), as well as memory management and file I/O routines. The graphics components of these tests determine how fast a system can execute basic graphics calls within Windows, including calls that display pixels, lines, rectangles, polygons, and ellipses. The graphics tests also exercise text display and BitBlt operations. BYTE's Windows tests were run in resolutions of 1024 by 768 pixels at 256 colors, and the DOS tests were run in VGA resolution.

The application tests give us accurate "real-world" representations of system performance; the only way to really know how well a system runs Microsoft Excel, for example, is to test with Excel. For DOS tests, we used WordPerfect 5.1, Lotus 1-2-3 release 2.4, FoxPro 2.0. and Autodesk Animator Pro 1.0. We ran Excel 4.0a, Microsoft Word 2.0b, and Lotus 1-2-3 for Windows 1.1 for our Windows evaluations.

In addition, we ran a set of tests on each system under SCO Unix. This suite consisted of the BYTE Lab's low-level Unix tests and SPEC89. The Unix tests cover a spectrum of typical scientific and engineering tasks, such as electronic-circuit analysis, architectural analysis, and compilation, as well as general Unix system operations. Therefore, the platforms were tested as scientific and engineering workstations, not as file servers or database processors.

USABILITY

We worked with each system to gauge its usability. For example, we rated systems according to how easy it was to perform simple upgrades; high marks

went to systems where the cover came off easily, add-in cards fit without problem, and the cover fit back on without undue fiddling. We evaluated memory expansion by determining how easy it was to access the open SIMM slots; similarly, we judged whether open drive bays were obstructed or difficult to reach. In addition, we evaluated the manuals provided by each vendor. Did one integrated manual come with the system, or was there a collection of manuals for each of the system parts? Were

the manuals well organized? As we found the answers to these and other questions, we kept extensive lab notes to refer to during our selection process.

FEATURES

We chose several features that we considered vital for high-end 486 systems:

- 32 MB or more of system-memory capacity
- local-bus graphics
- support for 1280- by 1024-pixel displays
- one or more drive bays available for expansion
- bundled applications software
- free one-year parts-and-labor

CONFIGURATION

We tested 50- or 66-MHz 486DX2 and 50-MHz 486DX systems in either desktop, mini-tower, or tower configurations. We accepted systems with ISA, EISA, and Micro Channel architecture buses. We specified up to 1 MB of hard disk cache. We didn't use any software cache that may have been supplied by ven-

We requested 8 MB of system RAM, the system's maximum amount of secondary processor cache RAM, and a 300- to 400-MB hard drive. Finally, we asked for each system's best graphics hardware configuration or a minimum of 1024- by 768-pixel resolution at 256 colors and 1 MB of VRAM. Test-configuration prices include a 14- or 15inch 1024- by 768-pixel or better monitor, whichever was standard.



Leslie Reisz (left), Alan Joch, and a few of the 116 systems we tested.

SELECTION

After we evaluated performance, features, and usability scores, we weighted our findings to help us select our winners. If you're buying a high-end system, you want speed and power, so we selected performance to be worth 50 percent of our final score. To determine our performance scores, we gave the most weight to tests based on applications related to each individual category (e.g., WordPerfect 5.1 and Lotus 1-2-3 release 2.4 for word processing and spreadsheet selection). Similarly, features represented 30 percent of our final determination; usability was 20 percent.

Contributors

Michael P. Connors, Contributing Editor of PC Digest (an NSTL publication), writes and researches comparative reviews of PCs.

Richard Fox, Senior Test Engineer/NSTL, has spent the last two years testing compatibility and performance of high-end PCs, software, and operating systems for NSTL.

Alan Joch, Senior Editor/BYTE, coordinates combined testing between the BYTE Lab and

Leonard Presberg, Manager of Performance Testing/NSTL, directed the development of NSTL's applications benchmarks for PCs. He holds a B.A. in computer science from Oberlin

Leslie Reisz, Senior Test Engineer/NSTL, wrote Unix interface programs for Unisys before joining NSTL in 1991. Since then, he has coordinated the testing of Unix systems and networks.

The Lab Report is an ongoing collaborative project between BYTE Magazine and National Software Testing Laboratories (NSTL), BYTE Magazine and NSTL are both operating units of McGraw-Hill, Inc.

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Poor Quality Control

f the 116 systems we tested, 40 experienced hardware problems that were significant enough to delay their testing. We solved some of the problems simply by opening the systems and ensuring that the power and data connections, as well as the adapter boards on the motherboard, were secure.

IDENTIFYING PROBLEMS

However, we called the vendors to identify at least half of the problems. For instance, when we powered up the Ares Microdevelopment 486-66DX2-VL, the system produced only a series of beeps. Hearing those beeps over the phone, the Ares technical staff instantly isolated the problem to a bad secondary processor cache.

Three systems, the Xinetron X/LAN, the Sho-Tronics 486 MAX DX2/66, and the Micro Express Micro Flex, experienced problems so severe that the vendors had to supply a new unit. In these cases, the problem systems would not boot at all, so no POST (power-on self test), video output, hard drive activity, or beeps occurred.

We contacted Wyse Technology after realizing that the Decision 486SE was clearly not operating at the expected speed of a 66-MHz DX2. During a conference call with several technicians, we checked each CMOS setting and DIP switch. We finally discovered that one of the DIP switches on the motherboard was between two settings. Once it was pushed into the proper setting, the system operated at the correct speed.

SCO UNIX

We experienced a number of problems installing SCO Unix, due in some degree to problems with third-party peripherals and their drivers. The two Gateway ISA IDE-drive desktops we tested worked fine. However, we had problems with the company's EISA towers, which shipped with UltraStor 24F SCSI controllers and Seagate hard drives. Unix would not install on the Gateway 4DX2-50V. It would install on the 4DX2-66V model, but the system would periodically lock up. Gateway sent us replacement Adaptec SCSI controllers. The 50MHz machine worked fine with the new controllers, but the 66-MHz version would no longer install SCO Unix. After more calls to Gateway, a technician suggested we turn the turbo switch off. This fixed the problem: Unix installed and ran-but very slowly.

Duracom's systems had similar problems. We tested two ISA IDE-drive machines and two EISA SCSI-drive

machines with Duracom's Adaptec clone controllers. The ISA machines ran fine, as did the EISA 50-MHz DX2. But the 66-MHz DX2 EISA would not install Unix. After a number of CMOS setting changes and system part swaps—SCSI controllers, hard drives, and CPUs-Duracom sent us a replacement Adaptec controller. Even with the new controller, we couldn't get

our tests to work correctly. We could not resolve this problem before press time.

The Ariel 486DX2-66VLS ISA and the Ares 486-66DX2-VL both had problems running the BYTE benchmark filesystem test. The Ares hit a kernel panic (i.e., an error from which the operating system cannot recover), and the Ariel system locked up during the test. Both had UltraStor SCSI controllers; the Ares ran a Quantum hard drive, and the Ariel ran a Toshiba hard drive. After several attempts, these systems successfully completed our tests.

The Lightning Thunderbox II also locked up during SCO Unix testing. After a number of tries, the tests finally ran, but the results were not consistent with the other test systems. Eventually, the Tekram SCSI controller failed completely. Lightning then sent a new Tekram controller, and from then on we had no problems running the tests.

VIDEO AND UNIX

There were a few machines whose original video cards would not work with SCO Unix. The CAF Technology Gold 6D2 and Gold 5T each came with a Poka video adapter, and both exhibited this problem. CAF sent two Western Digital VGA boards, which worked fine with Unix and were \$125 cheaper. The High Definition System HDEISA 50 came with an Orchid Prodesigner that was replaced with an Oak Technology Super VGA card, which was fine.

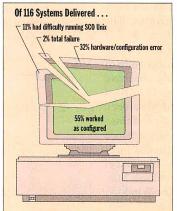
The Dell 466/L ran slow. After we attempted to solve the problem by swapping memory, Dell Computer's technical-support staff told us to put the 66DX2

> CPU into the 450/L, an identical machine. The new "466/L" ran as we expected.

> The Malone machine repeatedly locked up during testing. Technical support determined that the problem was due to the CMOS settings, and after a few adjustments, the problem was resolved.

Quill sent us a machine that would not install Unix. The installation procedure

could not make the file systems on the hard drive. After a controller jumperswitch change didn't work, Quill sent a different hard drive controller, which solved the problem.



TECHNICAL SUPPORT

Sometimes we found the responsiveness of technical support disappointing. We made repeated calls to Gateway 2000 for SCO Unix drivers. After getting no response, we resorted to downloading the drivers from UltraStor.

Most troubling about these problems was the sheer number. There were 40 systems that gave us some degree of hardware difficulty, which required time, patience, and technical expertise to correct. These figures paint a grim picture of the current state of the market.

In the end, we didn't see any correlation between the size of the vendor and the quality of the system. So-called upper-tier vendors (e.g., Dell and Gateway) were just as likely to send problem systems as were their smaller competitors. Our advice: Before buying a system from any vendor, make sure you are comfortable with the support and warranty options available.

WINDOWS

ur test specification of a high-end 486 with 8 MB of RAM and a 300-MB hard drive was a potent combination for Windows workstations. The processor and memory size kept the systems from balking as we ran through our suite of Windows applications that have grown to take up 10 MB of storage space and have been known to stall lesser systems.

Our Windows performance tests included important business applications like Excel 4.0a, Word for Windows 2.0b, and Lotus 1-2-3 for Windows 1.1. These benchmarks compared how well each system performed charting, file I/O, statistical-computation, searchand-replace, and spelling-checker functions, among dozens of others. Complementing these tests were the BYTE Windows benchmarks, which run custom tests that exercise eight specific graphics functions and help us see how effectively the graphics subsystems perform.

After we ranked systems for performance, we made our final selections by considering features, such as whether graphics subsystems supported resolutions of up to 1280 by 1024 pixels, the accessibility of internal components, the construction quality, and service and support options.

The 66-MHz 486s swept the Windows competition with every winner and runner-up, including those in the low-cost category. All 19 of the ranked systems used a local bus to speed graphics performance,

with two—the Dell 466/ME and the NEC Image 466—running a proprietary local-bus implementation. The remaining systems were all VL-Bus-based.

Best Overall, CompuAdd's 466 DX2 Desktop Power, sells for \$4039 and ranked near the top with an index score of 8.2 in the Windows tests. You'll get your money's worth from the

DIFFERENT BUS CHOICES

The bus is the common pathway that connects a computer's processor, memory, and peripheral control units. It's a term both for the common wiring paths that make up these connections and for the physical connectors (e.g., ISA sockets) into which expansion devices fit. Here are the current choices:

LOCAL BUS

A local-bus device connects directly to the processor bus and runs at processor clock speed (25 MHz for a DX2/50; 33 MHz for a DX2/66). Many vendors—including Dell and NEC—use proprietary local-bus designs. These are direct connections and are not designed for third-party peripheral expansion. The Video Electronics Standards Association has developed a local-bus standard known as VL-Bus. VL-Bus defines a connector for up to three local-bus devices. VL-Bus is a simple extension of the standard ISA bus, so local-bus systems and adapters can be designed with a minimal price premium. VL-Bus systems are available with both ISA and EISA systems. Intel has released a more sophisticated local-bus specification known as PCI (Peripheral Connect Interface). PCI allows the addition of up to 10 local-bus devices and supports concurrent CPU and bus-master operation. PCI also supports the new 64-bit Pentium processors; the VL-Bus does not. No systems or devices utilizing PCI are available as we go to press; however, they should be available later this year.

ISA BUS

This standard AT bus has several technical limitations. These include the inability to address more than 16 MB of RAM, an 8-MHz operating speed, and a theoretical 16-MBps data transfer rate.

Nevertheless, it remains the most popular choice for an expansion bus due to the large number of ISA boards available and its low cost.

MICRO CHANNEL ARCHITECTURE BUS

This 32-bit design put forth by IBM allows for bus-mastering devices and 40-MBps data transfer rates. It uses software-configurable boards (no messing with DIP switches or jumpers) and is software compatible with the ISA bus. The bus uses an entirely different connector than the ISA bus. Two disadvantages: Only a few vendors support it, and systems using it tend to be much more expensive than ISA systems.

EISA BUS

Another 32-bit bus that supports bus mastering and data transfer rates of up to 32 MBps. It's also compatible with existing ISA cards; this feature is EISA's best and worst aspect. EISA systems will accept ISA cards, but this acceptance can cause conflicts with the EISA configuration software. EISA configuration software cannot configure ISA cards or recognize ISA cards' settings. This means you still must configure ISA IRQs (interrupt requests) and other settings by hand. EISA systems used to command a large price premium over ISA systems, but that premium has dropped considerably in the last year.

\$2993 Zeos 486DX2-66. A Weitek graphics accelerator on the VL-Bus makes the Zeos system a fast Windows machine. It comes with 128 KB of 12-nanosecond secondary processor cache, support for up to 64 MB of system RAM, one free VL-Bus slot, a choice of several Lotus Windows applications, and excellent documentation. The performance score of the Dell 466/ME lagged behind the previous two systems, but slower performance was counterbalanced by useful features like a 16550 UART (universal asynchronous receiver/transmitter) for improved serial communications, and a 224-watt power

The best system for expansion, the Lightning Thunderbox II, also ranked within the top 6 percent for performance. The P C Pros/Touché 486/66 DX2 EISA VLB 5550T finished as a runner-up in this category, with good performance and features scores. However, its usability score was substandard: Cables obstructed all three EISA slots, and the CPU socket made only half-length cards viable. Moreover, the system was shipped with its DX2 processor in the P24T upgrade socket.

supply.

We also found the Microtech MT/VLB 486DX2/66 hard to use. Its two nine-pin serial ports were unmarked, and five of the seven ISA slots were limited to half-length cards due to poor placement of the RAM SIMM slots, a fan-mounted CPU, and secondary cache SIMM.

We named the \$2400 486/66 VESA tower system from High Definition System the best lowcost system, even though it ran our Windows tests slower than three runners-up. One runnerup that the High Definition machine bested was the 486DX2 system from Bi-Link, which frustrated us with its cramped mini-tower case that made adapter installation and memory expansion difficult.

KEY Tower Desktop

☐ Mini-tower VL = VL-Bus

${f BYTE}$ ${f BEST}$

Need a high-powered Windows workstation?

BEST OVERALL

CompuAdd 466 DX2 Desktop Power



The CompuAdd 466 DX2 Desktop Power posted the second fastest Windows performance score (behind the Comtrade VESA Local Bus Professional). Its fast graphics performance derives from the new Diamond Computer Viper video card with the Weitek Power 9000 chip set and 2 MB of VRAM. The video is connected through a VL-Bus

slot. The \$4039 price includes a CompuAdd 14-inch monitor with a video adapter that can display resolutions of up to 1280 by 1024 pixels (noninterlaced).



		PROCESSOR	CASE	PRICE	INDEX	USE UF	ROZ	(MAX. RES.)	HARD DRIVE	STANDARI	, ,
BEST	CompuAdd 466 DX2	486DX2/66		\$4039	8.2	Excellent	VL, ISA	1280 × 1024	500-MB IDE	256	256
RUNNER-UP	Zeos 486DX2-66	486DX2/66		\$2993	7.7	Excellent	VL, ISA	1280 × 1024	340-MB IDE	128	256
RUNNER-UP	Lightning Thunderbox II	486DX2/66		\$3895	8.1	Fair	VL, EISA	1280 × 1024	520-MB SCSI	1024	1024
RUNNER-UP	Dell 466/ME	486DX2/66		\$3669	7.3	Good	EISA1	1024 × 768	320-MB IDE	128	128
RUNNER-UP	Tri-Star 486 VL Station	486DX2/66		\$3279	7.5	Good	VL, ISA	1280 × 1024	340-MB IDE	256	256
RUNNER-UP	Comtrade VESA Local Bus	486DX2/66		\$2695	8.7	Fair	VL, ISA	1280 × 1024	340-MB IDE	256	256
RUNNER-UP	NEC Image 466	486DX2/66		\$3499	7.2	Excellent	ISA1	1024 × 768	340-MB IDE	256	256
RUNNER-UP	Gateway 4DX2-66V	486DX2/66		\$2995	7.5	Excellent	VL, ISA	1024 × 768	340-MB IDE	256	256

Searching for capacity as well as speed?

MOST EXPANDABLE

Lightning Thunderbox II



The graphics subsystem on the 66-MHz Thunderbox II is a Diamond Viper VL-Bus video card with 2 MB of VRAM and a Weitek Power 9000 chip set. The Diamond Viper supports modes of up to 1280- by 1024-pixel resolution. The Thunderbox has five available EISA slots and three available 51/4-inch drive bays. The system's EISA-based SCSI controller supports up to 16 MB of cache and 1024 KB of secondary cache to boost performance (most other systems contained 256 KB or smaller cache).

		PROCESSOR CASE	PRICE	SPEED INDEX	EASE OF USE	BUS	DISPLAY (Max. Res.)	HARD DRIVE	DRIVE 3½"	BAYS 5¼"
BEST	Lightning Thunderbox II	486DX2/66	\$3895	8.1	Fair	VL, EISA	1280 × 1024	520-MB SCSI	0	3
RUNNER-UP	Microtech MT/VLB 486DX2/66	486DX2/66	\$3099	7.5	Fair	VL, ISA	1280 × 1024	340-MB IDE	1	5
RUNNER-UP	P C Pros EISA VLB 5550T	486DX2/66	\$4721	7.9	Fair	VL, EISA	1280 × 1024	640-MB SCSI	3	3
RUNNER-UP	Ariel 486/DX2-66EVS	486DX2/66	\$4995	8.1	Fair	VL, EISA	1280 × 1024	877-MB SCSI	0	4
RUNNER-UP	Boss 466EV	486DX2/66	\$4495	7.3	Fair	VL, EISA	1024 × 768	340-MB SCSI	0	4
RUNNER-UP	Ares 486-66DX2-VL	486DX2/66	\$3519	7.6	Fair	VL, ISA	1024 × 768	525-MB SCSI	0	3

Want a low-cost, Windows-capable system?

LOW COST

High Definition HDVLB66



The \$2400 High Definition HDVLB66 includes a 14-inch Amax Impression Plus monitor with a video adapter that supports noninterlaced resolutions of up to 1280 by 1024 pixels. The graphics subsystem is a VL-Bus Genoa WindowsVGA 24 video card with a Cirrus Logic GD5426 chip set. The system also has a VL-Bus UltraStor hard drive controller connected to a 340-MB Fujitsu drive.

		PROCESSOR CASE	PRICE	SPEED INDEX	EASE OF USE	BUS	DISPLAY (Max. Res.)	HARD DRIVE	TECH. SUPPORT
BEST	High Definition HDVLB66	486DX2/66	\$2400	7.0	Fair	VL, ISA	1280 × 1024	340-MB SCSI	Lifetime
RUNNER-UP	Acma 486/DX2-66 VESA	486DX2/66	\$2595	7.3	Fair	VL, ISA	1024 × 768	360-MB IDE	12 months
RUNNER-UP	Bi-Link 486 VESA Local Bus	486DX2/66 □	\$2599	7.3	Fair	VL, ISA	1280 × 1024	360-MB IDE	Lifetime
RUNNER-UP	Image 486DX2-66VL	486DX2/66	\$2339	6.7	Fair	VL, ISA	1024 × 768	340-MB IDE	Lifetime
RUNNER-UP	Eastern Tech ET 486VLB66	486DX2/66	\$2595	7.3	Fair	VL, ISA	1024 × 768	340-MB IDE	Lifetime
RUNNER-UP	HiQ Super Power	486DX2/66	\$2699	6.3	Fair	VL, ISA	1280 × 1024	340-MB IDE	Lifetime

¹ Video is on proprietary local bus.



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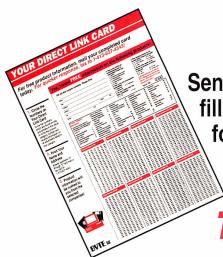
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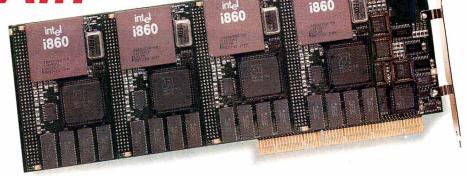
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Chips for Fast Graphics

With the battle of video-accelerator chips becoming more intense, we decided to see which chip sets performed the best in our BYTE Windows graphics tests. Our results showed that the Weitek Power 9000 graphics-coprocessor chip was the hands-down winner. Seven of the top 10 graphics performance systems contained a Weitek Power 9000 chip on the local bus. Of the next six top performers, three contained the S3-805 chip and three contained the ATI Mach 32. All 15 systems were of the same class: 66-MHz 486DX2 systems with all but two (the DECpc and the Unisys PW²) having the video adapter located on the local bus.

The Weitek Power 9000 chip was included primarily in Diamond Computer's Viper and in boards from Orchid. The Diamond Stealth 24 used an S3-805 chip, and the ATI Mach 32 was used only in the ATI Graphics Ultra Pro video board.

The following charts provide specifics on the graphics subsystems of all the BYTE Best and runner-up systems.

SYSTEM	VIDEO BOARD	CHIP	BYTE WINDOWS SPEED INDEX
Ariel 486DX2-66EVS	SixGraph	Weitek Power 9000	7.3
Bi-Link 486 VESA Local Bus	Star 2000	Weitek Power 9000	
Comtrade VESA Local Bus Professional	Diamond Viper	Weitek Power 9000	8.7
FutureTech System 462eV	Diamond Viper	Weitek Power 9000	8.4
HiQ Super Power 4DX2-66VLB	Diamond Viper	Weitek Power 9000	7.7
Lightning Thunderbox II	Diamond Viper	Weitek Power 9000	
P C Pros/Touché 486/66 DX2 EISA VLB 5550T	Karros	Weitek Power 9000	7.3
Zeos 486DX2-66	Diamond Viper	Weitek Power 9000	
CompuAdd 466 DX2 Desktop Power	ATI Graphics Ultra Pro	ATI Mach 32	8.3
CompuAdd MC 466EDX2	ATI Graphics Ultra Pro	ATI Mach 32	3.6
Gateway 4DX2/66V	ATI Graphics Ultra Pro	ATI Mach 32	5.1
Micro Express Micro Flex	ATI Graphics Ultra	ATI 38800	4.1
Microtech MT/VLB 486DX2/66	ATI Graphics Ultra Pro	ATI Mach 32	5.1
Tri-Star 486 VL Station	ATI Graphics Ultra Pro	ATI Mach 32	5.1
Unisys PW ² Advantage Plus 4666	ATI Graphics Ultra Pro	ATI Mach 32	4.7
Acma 486/DX2-50 ISA Workstation	Diamond Stealth 24	S3-805	4.4
Acma 486/DX2-66 VESA System	Diamond Stealth 24	S3-805	5.5
Ares 486-66DX2-VL	Diamond Stealth 24	S3-805	5.6
DECpc 466ST	Appian	S3-925	4.5
Dell 466/ME	Integrated	S3-805	5.4
Image 486DX2-66VL	Diamond Stealth 24	S3-805	5.3
AST Premmia 4/66d Model 343W	Integrated	Cirrus Logic GL542	
Boss 466EV	Genoa WindowsVGA 24	Cirrus Logic GL542	
Computer Expo CompuEx 486VLB/66	CompuEx LB	Cirrus Logic GL542	
Eastern Tech ET 486VLB66	Genoa WindowsVGA 24	Cirrus Logic GL542	
High Definition HDVLB66	Genoa WindowsVGA 24	Cirrus Logic GL542	
Key 486DX-50 VL-Bus Windowstation	Genoa WindowsVGA 24	Cirrus Logic GL542	26 3.5
NEC Image 466	Integrated	Tseng ET4000W32	
Xinetron X/LAN 486DX2 Workstation	Color Designer	Tseng ET4000AX	2.1
Computer Sales Professional Pro-486DX2/66	Paradise Accelerator Card for Windows	WD 90c31	2.6
Hertz 486/66Ei	Integrated	WD 90c30	1.7
Swan 486/50ES	Integrated	WD 90c30	1.3
Swan 486/66ES	Integrated	WD 90c30	1.6

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More Driver Dilemmas

very month we have a driver problem. Last month, Windows printer drivers gave us headaches. This month, Windows video drivers, SCO Unix disk drivers, and EISA configuration files all took their toll.

MISSING DRIVERS

It does you no good to spend extra money on an accelerated graphics card if the video driver doesn't support the accelerator. Make sure the system you purchase ships with the proper driver, and be sure the driver you receive is the latest. We had no less than three different versions of the video drivers for ATI's Mach 32 chip.

PLAN FOR UNIX

Be sure you have an SCO Unix driver that supports your drive controller card, or you won't even be able to install Unix. SCO supports most IDE drivers and Adaptec SCSI adapters, but we had problems with other SCSI adapters.

EISA .CFG FILES

We were astounded by the problems we had with missing EISA configuration files. While not driver files, EISA .CFG files allow each system's EISA configuration utility to properly configure the system and the adapter. If you are purchasing EISA, make sure you get the appropriate configuration disk for all adapters shipped with the system.

BACKUPS

Be diligent about keeping a backup of all drivers and configuration files, as well as any EISA configuration or setup utilities. Also make sure that the vendor doesn't just install the drivers on your



Software Bundles

With the price of systems dropping significantly in the past year, it's now easy to have

more money tied up in software than in hardware. Software bundles offered by systems vendors can be a significant savings that is often overlooked when purchasing systems. DOS and Windows were standard with most of the systems we reviewed. The vendors listed here offered much more. Also, you should make sure that you get original floppy disks for any preinstalled software, along with manuals and registration materials.

SOFTWARE
Choice of Turbo Pascal, Ami Pro, Lotus 1-2-3,
Freelance Graphics, Turbo C++, or Paradox
Choice of Borland C++, Quattro Pro, or Paradox
NetWare Lite
PFS:WindowWorks and Quicken
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Online Bible
Choice of eight applications or bundles
PFS:WindowWorks
Choice of Quattro Pro for Windows, Norton
Desktop, Object Vision, or Sidekick
Micrografx PhotoMagic
Quattro Pro for either DOS or Windows
America Online
Windows for Workgroups
Lotus Organizer and choice of 1-2-3 for
Windows, Ami Pro, or Freelance Graphics

system; insist on driver disks, too. That will help you avoid problems when reconfiguring. Dell's preinstalled Windows video driver was lost when we installed Unix. We had to retrieve the file from Dell's BBS to go back to running Windows in high resolution.

MADE TO ORDER

Buying a system is like ordering a meal at a fast-food restaurant—you can have it your way, if you know what to ask for. Before you order, ask yourself:

WHICH PROCESSOR DO I WANT?

The systems in this review all contain 486DX2/66, 486DX2/50, or 486DX/50 processors. For best performance, choose a 486DX2/66, which suprisingly doesn't command a huge price premium over a 50-MHz system.

HOW MUCH MEMORY DO I NEED? For DOS, get at least 4 MB; for Windows, 8 MB; and for Unix, 12 MB. More

dows, 8 MB; and for Unix, 12 MB. More memory is always better, especially for working in multitasking environments.

WHAT HARD DRIVE IS BEST?

For Windows users, 200 MB is probably the minimum; for DOS, at least 100 MB; and for Unix, where a full installation can take up about 170 MB, we recommend at least a 300-MB drive. IDE drives are often cheaper, but SCSI drives offer you daisy-chaining expandability.

DO I NEED A GRAPHICS ACCELERATOR?

The answer is yes, if it comes with drivers for the applications you run. In environments like Windows, speeding up your video will make more difference in performance than anything short of upgrading your processor.

WHAT KIND OF CASE SHOULD I CHOOSE?

Tower cases offer more expandability but can command a premium price. Slim-line desktop cases aren't as expandable, but they are good if desktop space is limited. New mini-tower designs are a good mix between desktops and towers.

SYSTEMS FOR

UNIX

o gauge Unix performance, we analyzed the BYTE Unix benchmarks and SPEC89. The file copy and the pipe elements of the BYTE suite gave us insights into hard drive speed. The SPEC tests run Unix applications to test system performance. The SPEC tests consist of computationally intense scientific and mathematical tasks such as simulation of electronic circuits and manipulation of complex math operations.

High scores in our Unix performance tests indicate systems with superior CPU speed and fast memory access times. All but two of our Unix-ranked systems relied on 66-MHz processors. The exceptions were the Swan 486/50ES, which posted the lowest speed scores in the two categories it appeared in as a runner-up: Best Overall and Most Expandable. Although this machine trailed in performance, its speeds were within 10 percent of the average, and the tower's design was one of the most flexible we saw, with eight free 3½-inch drive bays and six free EISA slots. The other 50-MHz machine, Micro Express's Micro Flex, ranked in the low-cost category on the strength of its acceptable performance, ease of use, and low \$1999 price tag.

In addition to speed, each system's features score accounted for 30 percent of our final choice. High physical-memory capacity is an important criterion for multitasking environments like Unix. Accordingly, when we rated systems for features, we gave the most points to models with motherboards that could hold the most memory. All nine systems in the Best Overall category could handle 32 MB; the standouts, including sys-

DISK CACHES: WHERE TO PUT YOUR MEMORY

Almost everyone in the computer industry can agree on this: Disk caches speed performance. A disk cache can be maintained by software in a section of system memory or held in dedicated memory on the hard drive controller. Here's what we learned about this speed-enhancing technique.

A HARDWARE CACHE ISN'T NECESSARILY BETTER THAN A SOFTWARE CACHE. Vendors tout caches on the hard drive controller (or on the drive itself). We ran tests on the Micron Computer 486VL WinStation 466 with a Tekram local-bus IDE controller using both a 4- and a 1-MB cache on the drive controller. Next, we ran the same system using a 4-MB software cache under

Windows 3.1's SmartDrive. The result: SmartDrive slightly outperformed the similar-size hardware cache.

There are several reasons why this may be the case. Even though the controller we used was in a VL-Bus slot, accessing the data cached in main system memory may have been faster than accessing the memory on the drive controller. Presumably, this difference may be even greater on traditional

ISA or EISA systems. Also, SmartDrive may provide a better caching algorithm than Tekram hardware.

A SOFTWARE CACHE IS MORE FLEXIBLE THAN A HARDWARE CACHE.

You can easily reconfigure a software cache. Changing the settings on a hardware cache often means rebooting and accessing the system setup utility or even using your EISA configuration software. Also, the memory dedicated to a software disk cache may be used as regular system memory when the cache is turned off, while the memory on a drive controller card is completely committed.

Hardware caches may have an advantage in data integrity. If your system happens to lock up as a software cache writes, you will likely lose data. With a hardware cache, that data is likely to be written out and not lost. Neither write-caching implementation will save you from losing data on a power loss, however.

In most cases, you're better off spending the money you'd have spent on a hardware cache on system memory instead. That way, you have the option to portion the additional RAM as cache or as main memory, whichever improves performance most.

tems from AST, CompuAdd, Hertz, Swan, and Unisys could accommodate 128 MB of RAM on the main memory board. All the systems in the Best Overall category contained 256 KB of secondary cache, except for the Unisys PW² Advantage Plus, which comes with 128 to 256 KB of expandable RAM cache. The AST Premmia can handle a cache as large as 512 KB. A second processor cache is more beneficial for Unix operation than for DOS or Windows due to the large programs, multitasking, and heavy computational tasks involved in Unix.

Graphical environments such as the X Window System stress the video subsystem and make a system's video speed a performance bottleneck. Although our tests were not graph-

video modes.

All the systems in our test sample supported displays of at least 1024 by 768 pixels; we gave extra points to AST's Premmia 4/66d and the CompuAdd 466 DX2 Desktop Power, both of which came with 2 MB of VRAM and supported display resolutions of 1280 by 1024 pixels (noninterlaced).

Although the floating-point operation of these high-end 486 systems lags behind that of RISC-based workstations, often the choice for Unix users, many of the 486s contained a socket for the addition of a Weitek math coprocessor that will help boost performance of floating-point tasks.

The large applications and data files common in the Unix world make storage expandability an important consideration. Our features ratings gave extra emphasis to the systems with the most drive bays. Similarly, we considered open drive bays important for CD-ROM—increasingly the delivery media of choice for Unix software vendors—or tape backup. Not surprisingly, 12 of our 17 ranked Unix systems were tower cabinets, while all five of the remaining ranked systems were mini-tower designs.

The remainder of our evaluation was based on ease of use. Here we rated each system for how quickly we could add hard drives and expansion cards, whether expansion areas were free of wiring and other obstructions, and how clear and comprehensive the accompanying users manuals were.

KEY

■ Desktop

Tower

☐ Mini-tower VL = VL-Bus

BYTE BEST

UNIX

Plan to run Unix on a desktop 486?

BEST OVERALL

Hertz 486/66Ei



The combined BYTE Unix benchmark and SPEC benchmark results for this tower were better than those of any system we tested. The Hertz system also offers a maximum of 128 MB of 32-bit memory on the main memory board (compared to 32 and 64 MB for the runner-up DECpc and the NEC Image 466, respectively). This, along with a maximum of 256 KB of secondary cache

helps the Hertz system handle multiple sessions and large Unix applications. The system's Adaptec hard drive controller and Micropolis 1.2-GB SCSI hard drive recorded the fastest score overall on the BYTE Unix File Copy test-20 percent better than the Unisys PW2 Advantage Plus 4666, the second fastest Unix system overall.



UADO DDIVE

DAM CACUE /VD\

ę		PROCESSOR	CASE	PRICE		EASE OF USE	BUS	DISPLAY (Max. Res.)	HARD DRIVE	RAM CACHE Standard	(KB) Max.
BEST	Hertz 486/66Ei	486DX2/66		\$5870	9.0	Excellent	EISA	1024 × 768	1.2-GB SCSI	8	128
RUNNER-UP	Swan 486/50ES	486DX/50	ı	\$5969	8.2	Excellent	EISA	1024 × 768	325-MB SCSI	16	128
RUNNER-UP	CompuAdd 466 DX2	486DX2/66		\$4039	8.4	Excellent	VL, ISA	1280 × 1024	500-MB IDE	8	256
RUNNER-UP	AST Premmia 4/66d	486DX2/66		\$5090	8.4	Good	VL, EISA	1280 × 1024	340-MB IDE	8	128
RUNNER-UP	DECpc 466ST	486DX2/66		\$5449	8.8	Good	EISA	1024 × 768	1-GB SCSI	8	32
RUNNER-UP	Unisys PW ² Advantage Plus	486DX2/66		\$6552	8.7	Excellent	EISA	1024 × 768	1-GB SCSI	8	128
RUNNER-UP	NEC Image 466	486DX2/66		\$3499	8.5	Excellent	ISA ¹	1024 × 768	340-MB IDE	8	64

Need a Unix system with room for options?

MOST EXPANDABLE





In addition to excelling in Unix performance (see item above), the Hertz 486/66Ei stood out as an expandable system. The system can address a maximum of 384 MB of 32-bit memory. The tower case has eight available 31/2-inch hard drive bays and eight adapter slots. The drive bays are easily accessible and free from obstructions, such as wiring or adapters.

CDEED EACE OF DISC

	132169	THOULSSON	UNOL	TRICE		USE	003	(MAX. RES.)	HARD DRIVE	STANDARD	, ,
BEST	Hertz 486/66Ei	486DX2/66		\$5870	9.0	Excellent	EISA	1024 × 768	1.2-GB SCSI	8	128
RUNNER-UP	Swan 486/50ES	486DX/50		\$5969	8.2	Excellent	EISA	1024 × 768	325-MB SCSI	16	128
RUNNER-UP	Boss 466EV	486DX2/66	ı	\$4495	8.3	Fair	VL, EISA	1024 × 768	340-MB SCSI	8	256
RUNNER-UP	Microtech MT/VLB	486DX2/66		\$3099	8.2	Fair	VL, ISA	1280 × 1024	340-MB IDE	8	64
RUNNER-UP	Lightning Thunderbox II	486DX2/66		\$3895	8.2	Fair	VL, EISA	1280 × 1024	520-MB SCSI	8	256
RUNNER-UP	Ares 486-66DX2-VL	486DX2/66		\$3519	8.6	Fair	VL, ISA	1024 × 768	525-MB SCSI	8	64

Seeking power for Unix at a bargain price?

LOW COST

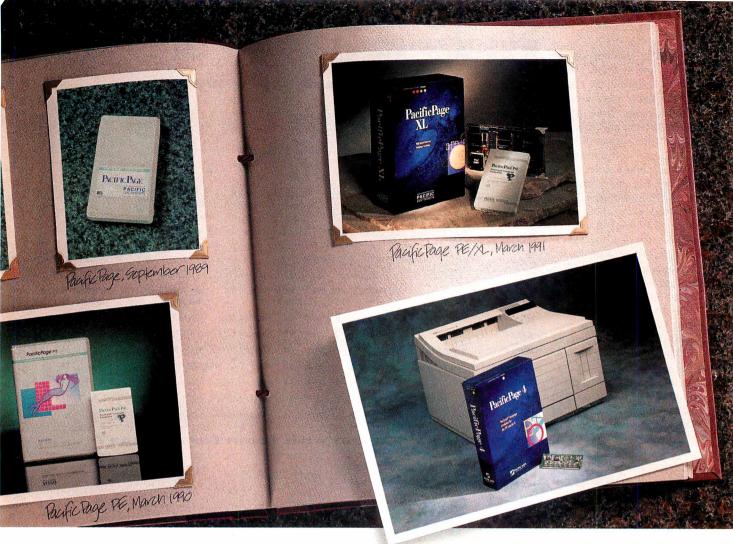
High Definition HDVLB66



This \$2400 tower system ran our Unix tests faster than any other low-cost system. To optimize graphics and hard drive performance, the system used the VL-Bus for its Genoa WindowsVGA 24 video card and the UltraStor SCSI drive controller. The HDVLB66 can hold a maximum of 1 MB of secondary cache RAM (most of the Unix-ranked systems topped out at 256 KB). The system can hold 256 MB of 32-bit RAM on the main memory board. The system also offers one free drive bay.

		PROCESSOR C	ASE	PRICE	SPEED Index	EASE OF USE	BUS	DISPLAY (MAX. RES.)	HARD DRIVE	RAM CACHE Standard		
	BEST	High Definition HDVLB66	486DX2/66		\$2400	8.1	Fair	VL, ISA	1280 × 1024	340-MB SCSI	8	32
	RUNNER-UP	Computer Sales Professional	Pro-486DX2/66		\$2199	7.2	Good	ISA	1024 × 768	212-MB IDE	8	32
	RUNNER-UP	Eastern Tech ET 486VLB66	486DX2/66		\$2595	7.9	Fair	VL, ISA	1024 × 768	340-MB IDE	8	32
	RUNNER-UP	Acma 486/DX2-66 VESA	486DX2/66		\$2595	7.5	Fair	VL, ISA	1024 × 768	360-MB IDE	8	32
	RUNNER-UP	Micro Express Micro Flex	486DX/50		\$1999	6.3	Good	ISA	1024 × 768	325-MB IDE	8	32
	RUNNER-UP	Key VL-Bus Windowstation	486DX/50		\$2395	6.7	Fair	VL, ISA	1024 × 768	210-MB IDE	8	32

¹ Video is on proprietary local bus



Introducing PacificPage 4. The latest addition to a very prominent family.

The latest member of the award winning PacificPage® family has arrived. Called PacificPage 4, it's designed just for the new

LaserJet® 4 printer.

Like all of its earlier family members, PacificPage 4 provides full PostScript® language emulation. The same 35 Apple® LaserWriter® scalable typestyles. And all of PostScript's powerful graphics capabilities. It also accepts downloaded Type 1 and 3 font formats.

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And your PostScript files will be printed quickly because PacificPage 4 utilizes the i960[™] processor built into each LaserJet 4.

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That's because PacificPage 4 fully supports the automatic language sensing and switching feature of the LaserJet 4.

> Like all of the PacificPage products before it, PacificPage 4 is covered by a full lifetime warranty and is backed by a 60-day money back guarantee of satisfaction.

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For the dealer nearest you or to order PacificPage 4, call (619) 625-3628, Fax (619)

run in the family. 552-0889.

PostScript language emulation for the LaserJet 4

> Be sure to ask about Pacific 4 SIMM Memory $^{\text{\tiny M}} - 1$, 2, 4, and 8 MB memory upgrades for the LaserJet 4.





HONORABLE MENTIONS



The Gateway 2000 manuals were comprehensive, organized in a straightforward way, and easy to use. Most systems in the roundup supplied a different manual for each subsystem—one for the hard drive controller, one for the video card, two for the motherboard, and so

on—but Gateway 2000 chose a better approach. Gateway's systems include a single, integrated manual with one index and one glossary. This one-stop documentation made it much easier to configure and work with Gateway's machines. And the glossary not only covers system components, but it also includes definitions of general computing terms (i.e., everything from open architecture and multitasking to hacker and nerd).

IBM Adapter-Card Connectors It's easy to put adapter cards into the IBM PS/2 Model 77 DX2. Adapter cards are held down by a single thumbscrew at the bottom of the card instead of one at the top of the card. With other systems, you not only need a screwdriver, but the case and motherboard must be aligned precisely to make sure cards are seated.



Zenith Modularity The Zenith Z-Station system's modular design lets you quickly replace or upgrade every system component. The CPU, video adapter, Ethernet port, and SCSI port each are located on an easily removable card. The same motherboard can accept a proprietary EISA bus or ISA bus card that provides four horizontal slots. The hard drive and floppy drive come in a single chassis that require only one power connection and no data cables. Memory SIMMs are easily accessible, and there are six open banks for RAM expansion.

Dubious Achievements

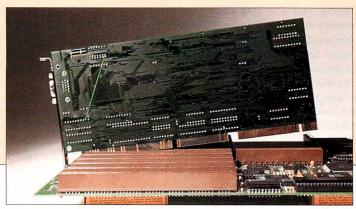
CAF Parallel Port The CAF Technology Platinum 5B came to us with its parallel-port connectors inserted upside down into the port's metal faceplate. Consequently, the larger end of the connector (with 13 pins) was



aligned with the smaller end of the faceplate and vice versa. This must have been difficult to accomplish since both the case and port are designed to fit together one way only. As such, this parallel port is completely useless; no parallel-printer cable or any other device meant for this port can attach to it since the pin holes are facing in the opposite direction from the faceplate.

VL-Bus Connectors The VL-Bus specification defines a new card-edge connector. The connector adds a short extension to standard ISA or EISA slots, making VL-Bus sockets more versatile. However, the extended

connector also means you must fit almost 9 inches of card edge into a socket when installing VL-Bus cards. That makes it very difficult to seat an adapter properly. One side of the adapter will snugly snap into place, but the other end will pop out, making installing most VL-Bus cards like riding a seesaw.



ROLL CALL OF SYSTEMS TESTED

VENDOR	MODEL	PERFORMANCE	EASE OF USE	PRICE	PHONE	TOLL-FREE NO.	INQUIRY N
CAF Technology, Inc.	Gold 5T	5.5	Fair	\$3049	(818) 369-3690	N/A	976
CAF Technology, Inc.	Platinum 5B	5.7	Fair	\$3149	(818) 369-3690	N/A	977
Deico Electronics	Predator-I	5.9	Excellent	\$2995	(510) 651-7800	(800) 321-8990	978
Image Microsystems	Image 486DX-50	6.2	Fair	\$2189	(310) 815-1000	(800) 729-3400	979
Keydata International, Inc.	Key 486DX-50 VL-Bus Windowstation	6.2	Fair	\$2395	(908) 755-0350	(800) 482-7010	980
Micro Express	Micro Flex (ME 486-50)	5.7	Good	\$1999	(714) 852-1400	(800) 989-9900	981
PC Craft	PCC 2804-50IS	5.7	Fair	\$2099	(714) 256-5000	(800) 938-4888	982
Swan Technologies, Inc.	486/50ES	5.4	Excellent	\$5969	(814) 234-2236	(800) 468-9044	983
Acma Computers, Inc.	486/DX2-50 ISA Workstation	6.1	Good	\$2295	(510) 623-1212	(800) 786-6888	984
American Mitac Corp.	LanMaster 6000E	5.4	Fair	\$4795	(510) 623-5300	(800) 765-6972	985
Compaq Computer Corp.	DeskPro 50M	5.6	Excellent	\$3734	(713) 370-0670	(800) 765-6572	986
Compudyne Products, Inc.	486/DX2-50 VLB	6.1	Fair	\$2439	(214) 702-5600	(800) 932-2667	987
Dell Computer Corp.	450/L	6.0	Fair	\$2919	and the second company of the second	SALES NAME OF THE OWNER OF THE OWNER OF THE OWNER OF THE OWNER OWNER OWNER OWNER OWNER OWNER OWNER OWNER OWNER	
Dell Computer Corp.	450/ME				(512) 338-4400	(800) 289-3355	988
		6.0	Good	\$3569	(512) 338-4400	(800) 289-3355	989
Digital Equipment Corp.	DECpc 450d2 MT	5.3	Good	\$2899	(508) 493-5111	(800) 722-9332	990
Digital Equipment Corp.	DECpc 450ST	5.8	Good	\$4849	(508) 493-5111	(800) 722-9332	991
Duracom Computer Systems	DeskSaver 486/50DX2	5.3	Fair	\$2449	(214) 518-1200	(800) 551-9000	992
Duracom Computer Systems	DeskSaver 486/50DX2 E	5.3	Fair	\$3149	(214) 518-1200	(800) 551-9000	993
Gateway 2000	4DX2-50E	5.0	Excellent	\$3495	(605) 232-2000	(800) 523-2000	994
Gateway 2000	4DX2-50V	5.8	Good	\$2495	(605) 232-2000	(800) 523-2000	995
Grid Systems Corp.	MFP 450 Plus	4.8	Fair	\$4138	(817) 491-5200	(800) 934-4743	996
High Definition System, Inc.	HDEISA 50	6.0	Fair	\$2850	(408) 720-0493	(800) 347-0493	997
Lucky Computer Co.	LSI-486/50/VLB	6.2	Fair	\$2395	(214) 690-6110	(800) 966-5825	998
Micron Computer	486VL WinStation 450	6.5	Poor	\$3349	(208) 465-3424	(800) 438-3343	999
Microtech Computer Corp.	MT486DX-50	6.1	Fair	\$2699	(404) 345-6508	(800) 342-6508	1334
Sho-Tronics, Inc.	486 Tech DX2/50	4.7	Fair	\$1978	(602) 780-5920	(800) 289-8881	1335
Tandy Corp.	450 DX2	4.9	Good	\$2749	(817) 390-3011	N/A	1336
Zenith Data Systems	Z-Station 450XEh	5.4	Good	\$3549	(708) 808-5000	(800) 553-0331	1337
Zenith Data Systems	Z-Station 450Xh	5.1	Fair	\$3249	(708) 808-5000	(800) 553-0331	1338
Acma Computers, Inc.	486/DX2-66 VESA System	7.4	Fair	\$2595	(510) 623-1212	(800) 786-6888	1339
71 AN	ALR Evolution IV 4/66d Model 240DW	6.7	Fair	\$3211	(714) 581-6770	(800) 444-4257	1340
Aims Information Systems	EISA-VLB486	7.6	Good	\$3698	(408) 456-0111	(800) 697-2467	1341
Alpha Computer Concepts, Inc.		7.0	Poor	\$2999	(404) 662-8776	(800) 682-5742	1342
Altec Technology Corp.	486DX2/66	6.0					
			Fair	\$2699	(818) 969-2988	(800) 255-9971	1343
American Mitac Corp.	Ballistic 486/66	7.3	Poor	\$2995	(510) 623-5300	(800) 765-6972	1344
Ares Microdevelopment	486-66DX2-VL	7.2	Fair	\$3519	(313) 473-0808	(800) 322-3200	1345
Ariel Design, Inc.	486DX2-66EVS	7.3	Fair	\$4995	(617) 982-8800	(800) 882-7435	1346
Ariel Design, Inc.	486DX2-66VLS	6.9	Fair	\$3895	(617) 982-8800	(800) 882-7435	1347
AST Research, Inc.	Bravo 4/66d Model 213W	6.0	Excellent	\$2880	(714) 727-4141	(800) 876-4278	1348
AST Research, Inc.	Premmia 4/66d Model 343W	6.6	Good	\$5090	(714) 727-4141	(800) 876-4278	1349
Bi-Link Computer, Inc.	486 VESA Local Bus	6.7	Fair	\$2599	(310) 692-5345	(800) 888-5369	1350
Boss Technology	466EV	7.5	Fair	\$4495	(404) 636-2126	(800) 628-1787	1351
Boss Technology	466IV	7.0	Fair	\$3995	(404) 636-2126	(800) 628-1787	1352
CAF Technology, Inc.	Gold 6D2	6.2	Fair	\$3129	(818) 369-3690	N/A	1353
CAF Technology, Inc.	Platinum 6T2	6.2	Fair	\$3379	(818) 369-3690	N/A	1354
Caliber Computer Corp.	SYS14	6.8	Fair	\$2599	(408) 942-1220	(800) 995-4594	1355
CIC Computers Ltd.	CIC-Sigma 466 DS	6.4	Good	£2699	+44 81 813 8217	N/A	1356
Compaq Computer Corp.	DeskPro 66i	6.2	Fair	\$3019	(713) 370-0670	(800) 345-1518	1357
Compaq Computer Corp.	ProLinea 4/66i	6.3	Fair	\$2698	(713) 370-0670	(800) 345-1518	1358
Compaq Computer Corp.	ProSignia 486DX2/66-550	6.8	Fair	\$5459	(713) 370-0670	(800) 345-1518	1359
CompuAdd Computer Corp.	466 DX2 Desktop Power	7.4	Excellent	\$4039	(512) 250-1489	(800) 627-1967	1360
CompuAdd Computer Corp.	MC 466EDX2	6.0	Excellent	\$6884	(512) 250-1489	(800) 627-1967	1361
Compudyne Products, Inc.	486/DX2-66 VLB	7.3	Fair	\$2639	(214) 702-5600	(800) 932-2667	1362
Computer Expo	CompuEx 486VLB/66	7.0	Fair	\$2567	(713) 531-0990	(800) 229-3976	1363
Computer Sales Professional	Pro-486DX2/66	5.8	Good	\$2199	(908) 560-1143	(800) 950-6660	1364
Computers by Malone	CBM 466	6.0	Fair	\$2589			
					(402) 333-6783	(800) 842-0906	1365
CompuTrend Systems, Inc.	Premio VESA DX2-66	5.8	Poor	\$2150	(818) 333-5121	(800) 677-6477	1366

VENDOR .	MODEL	PERFORMANCE	EASE OF USE	PRICE	PHONE	TOLL-FREE NO.	INQUIRY NO
Comtrade	VESA Local Bus Professional	7.5	Fair	\$2695	(818) 961-6688	(800) 969-2123	1367
CoreMicro Systems	Core VLB-66	7.5	Poor	\$3295	(408) 452-2752	(800) 369-2783	1368
Data Storage Marketing, Inc.	DataStor 486-66 DX2 EISA	6.6	Excellent	\$3545	(303) 442-4747	(800) 543-6098	1369
Data Storage Marketing, Inc.	DataStor 486-66 DX2 ISA/VL	6.6	Excellent	\$3195	(303) 442-4747	(800) 543-6098	1370
Deico Electronics	Predator-II 486DX2	6.6	Good	\$2895	(510) 651-7800	(800) 321-8990	1371
Dell Computer Corp.	466/L	7.2	Fair	\$3219	(512) 338-4400	(800) 289-3355	1372
Dell Computer Corp.	466/ME	7.1	Good	\$3669	(512) 338-4400	(800) 289-3355	1373
Digital Equipment Corp.	DECpc 466ST	6.4	Good	\$5449	(508) 493-5111	(800) 722-9332	1374
DTK Computer, Inc	Feat-6630V	7.0	Fair	\$3599	(818) 810-8880	(800) 289-2385	1375
Duracom Computer Systems	DeskSaver 486/66DX2 E	6.2	Poor	\$3299	(214) 518-1200	(800) 551-9000	1376
Duracom Computer Systems	FilePro 486/66DX2	5.9	Fair	\$2699	(214) 518-1200	(800) 551-9000	1377
Eastern Tech Corp.	ET 486VLB66	7.7	Fair	\$2595	(718) 459-1407	(800) 289-8128	1378
Epson America, Inc.	Progression 486DX2/66	6.0	Excellent	\$3986	(310) 782-0770	(800) 922-8911	1379
	FCS 486-66 P	7.2	Fair	\$3099			1380
First Computer Systems, Inc.					(404) 441-1911	(800) 325-1911	
First Computer Systems, Inc.	FCS 486-66 VLB	6.3	Fair	\$2699	(404) 441-1911	(800) 325-1911	1381
FutureTech Systems Inc.	System 462e	6.0	Fair	\$3429	(201) 488-4414	(800) 275-4414	1382
FutureTech Systems Inc.	System 462eV	6.9	Good	\$3129	(201) 488-4414	(800) 275-4414	1383
Gateway 2000	4DX2-66E	6.1	Excellent	\$3495	(605) 232-2000	(800) 523-2000	1384
Gateway 2000	4DX2-66V	7.1	Excellent	\$2995	(605) 232-2000	(800) 523-2000	1385
Grid Systems Corp.	MFP 466 Plus	5.7	Fair	\$4167	(817) 491-5200	(800) 934-4743	1386
Hertz Computer Corp.	486/66Ei	5.9	Excellent	\$5870	(212) 684-4141	(800) 232-8737	1387
High Definition System, Inc.	HDISA66	4.8	Fair	\$1950	(408) 720-0493	(800) 347-0493	1388
High Definition System, Inc.	HDVLB66	6.9	Fair	\$2400	(408) 720-0493	(800) 347-0493	1389
HiQ Systems, Inc.	HiQ Super Power 486DX2-66VLB	6.0	Fair	\$2699	(408) 245-5836	(800) 827-5836	1390
IBM Personal Computer Co.	IBM PS/2 Model 77 486DX2	5.5	Good	\$4670	(914) 766-1900	(800) 772-2227	1391
Image Microsystems	486DX2-66VL	6.7	Fair	\$2339	(310) 815-1000	(800) 729-3400	1392
Lapine Computer	4661	6.0	Poor	\$2799	(818) 884-3685	(800) 927-3772	1393
Lapine Computer	466VL	6.6	Poor	\$2299	(818) 884-3685	(800) 927-3772	1394
Legacy Technology	VESA 486DX2-66		_1	\$2750	(818) 854-8288	(800) 832-8883	1395
Lightning Computers, Inc.	Omniflex 66	6.8	Poor	\$2495	(415) 543-3111	(800) 347-4486	1396
Lightning Computers, Inc.	Thunderbox II	7.7	Fair	\$3895	(415) 543-3111	(800) 347-4486	1397
Lucky Computer Co.	LSI-486/66/ELB	6.2	Fair	\$2995	(214) 690-6110	(800) 966-5825	1398
Micro Express	ME 486-VL/DX2/66	6.8	Good	\$3480	(714) 852-1400	(800) 989-9900	1399
Micro Professionals	Pro Series 486DX2/66LB	6.8	Fair	\$2169	(708) 339-8398	(800) 800-8300	1400
Micron Computer	486VL WinStation 466	8.0	Fair	\$3549	(208) 465-3434	(800) 438-3343	1401
Microtech Computer Corp.	MT/VLB 486DX2/66	7.3	Fair	\$3099	(404) 345-6508	(800) 342-6508	1402
NEC Technologies, Inc.	Image 466	7.2	Excellent	\$3499	(508) 264-8000	(800) 388-8888	1403
P C Pros/Touché	Touche 486/66 DX2 EISA VLB 5550T	6.9	Fair	\$4721	(708) 810-1010	N/A	1404
Personal Computer Graphics	Turbo Max 80	8.6	Fair	\$2895	(310) 214-0550	(800) 255-9893	1405
Polywell Computers, Inc.	Poly 486-66EV	7.3	Fair	\$4300	(415) 583-7222	(800) 999-1278	1406
Polywell Computers, Inc.	Poly 486-66VZ	7.4	Fair	\$2800	(415) 583-7222	(800) 999-1278	1407
Quill Corp.	QTech 4D266-VL	6.2	Poor	\$2299	(708) 634-6650	N/A	1408
Santron Computer	Senior Partner 486	7.6	Fair	\$2895	(415) 571-1619	(800) 938-7555	1409
Sho-Tronics, Inc.	486 MAX DX2/66	6.3	Fair	\$2355	(602) 780-5920	(800) 289-8881	1410
Sirex USA, Inc.	486DX2-66 EISA	4.5	Fair	\$3299	(718) 746-7500	N/A	1411
Sirex USA, Inc.	486DX2-66 ISA Local Bus	6.1	Fair	\$3099	(718) 746-7500	N/A	1412
Swan Technologies, Inc.	486 DX2-66DB	6.3	Excellent	\$3149	(814) 234-2236	(800) 468-9044	1413
Swan Technologies, Inc.	486/66ES	5.6	Excellent	\$6069	(814) 234-2236		
Tandy Corp.	466 DX2	5.6	Fair	\$3264	(817) 390-3011	(800) 468-9044 N/A	1414 1415
Transource Computers	Verxion 486-66 VL-Bus	6.5	Fair		· · · · · · · · · · · · · · · · · · ·	N/A N/A	
Tri-Star Computer Corp.				\$2383	(602) 997-8101		1416
	486 VL Station	7.2	Good	\$3279	(602) 961-3401	(800) 800-7668	1417
Unisys Corp.	PW ² Advantage Plus 4666	6.7	Excellent	\$6552	(215) 986-4011	(800) 448-1424	1418
Vektron International, Inc.	486DX2/66	7.4	Fair	\$2199	(214) 606-0280	(800) 725-0020	1419
Wyse Technology	Decision 486SE-66DX2	5.9	Excellent	\$4381	(408) 473-1200	(800) 438-9973	1420
Xinetron, Inc.	X/LAN 486DX2 Workstation	6.6	Excellent	\$2699	(408) 727-5509	(800) 345-4415	1000
Zenith Data Systems	Z-Station 466XEh	6.3	Good	\$3749	(708) 808-5000	(800) 553-0331	1001
Zenith Data Systems	Z-Station 466Xh	5.5	Good	\$3449	(708) 808-5000	(800) 553-0331	1002
Zeos International Ltd.	486DX2-66	6.9	Excellent	\$2993	(612) 633-4591	(800) 554-5226	1003
Zeos International Ltd.	486DX2-66 EISA	6.3	Fair	\$4390	(612) 633-4591	(800) 554-5226	1004

Unable to run the test suite; problem unresolved at press time.

Introducing Matrox MGA, the new series of 64-bit graphics accelerators for the PC Power User.

MGA's 64-bit graphics engine surpasses regular 32-bit technology to deliver workstation

graphics performance for CAD and Windows professionals. MGA gives you up to 12 times more hardware performance and up to 60 million WinMarks.

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resolutions, true color, real-time 3D and the best productivity enhancing features.

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and zoom, virtual of

Just a few of the 16.7 million colors to choose from.

tion switching without having to leave your application or restart Windows. MGA displays 1024 x 768 in full 24-bit color and up to 1600 x 1200 in near true color

21.2

with QCDP, Matrox's exclusive color quality dithering process.

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quality Gouraud shading. DynaView gives you the smoothest real-time pan and zoom in the industry.

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CAD and

Multimedia. MGA's

Upgrade Options let you

capture broadcast quality video, output graphics to standard video devices or increase your printing speed up to 600%.

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The Multiprocessor Solution

New architectures overcome I/O performance bottlenecks



DICK POUNTAIN

Multiprocessor file servers are big business. Every major player in the PC market either has one of its own or is working furiously to develop one. But it was

not always this way.

Four years ago, pundits dubbed the then-upcoming Intel 486 a "mainframe on a chip." Had this label been accurate, a single-processor 486 system could have served an entire corporate department. But it was only a halftruth. A single 486 might outpace an old mainframe in floating-point calculations, but the strength of superminicomputers and mainframes rests on a balance between great computing power and equally great I/O bandwidth. While PC computing power has grown 80-fold in 10 years—from 0.5 MIPS for the original IBM PC to 40 MIPS for a 486DX2-66 system—I/O performance

has failed to keep pace. Even the Micro Channel and EISA buses offer a barely fivefold improvement.

Multiprocessor systems fill this performance gap. They use multiple CPUs to spread the I/O burden as well as to increase computational power, and their manufacturers are adopting architectures that are strongly influenced by superminicomputers, mainframes, and even supercomputers.

The Multiprocessor Defined

Systems designers have come up with many approaches to building a multiprocessor computer (see "All Systems Go," August 1992 BYTE). But here I'll focus only on shared-memory multiprocessor architectures, which connect several CPUs to a single shared-memory space.

The major alternative to the shared-memory multiprocessor approach is the message-passing multicomputer, in which each CPU has its own private memory space. Here, interprocessor communication takes place by way of messages sent over a sep-

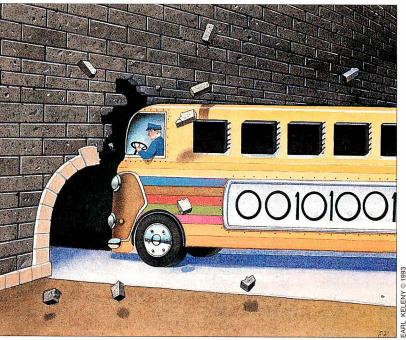
arate communications network. The high bandwidth available from a dedicated communications network lets designers combine hundreds—or even thousands—of CPUs in a single machine. That's why most massively parallel supercomputers are message-passing machines.

In contrast, shared-memory multiprocessor architectures are limited to at most tens of processors, and many commercial machines offer no more than four. It's difficult to design a bus that allows more processors to access

shared memory without creating a severe bottleneck. However, shared-memory machines have an enormous advantage: They can run, unmodified, software written for single-processor PCs. In contrast, message-passing machines impose completely new programming techniques and usually require custom software.

Shared-memory multiprocessors that are based on industry-standard CPUs such as the Intel 486 or the Sun SPARC make excellent fast file servers or database servers, running industry-standard operating systems like Unix and NetWare (and, soon, Windows NT) with multiprocessing extensions. They exhibit a coarse-grained form of parallelism in which a whole program or Unix process is the smallest unit allocatable to a different CPU, and the operating system performs this allocation automatically.

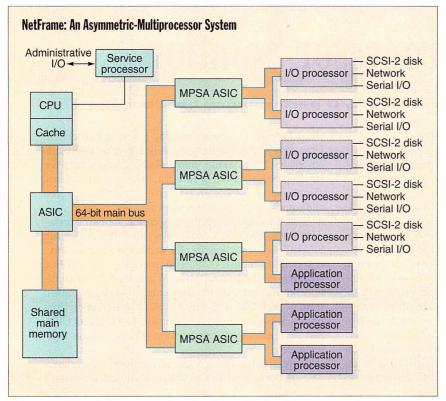
Currently, Intel-based shared-memory multiprocessors are not as effective as compute servers; they won't



accelerate recalculation of your Excel spreadsheets, for instance, because the code that calculates the cells is not multithreaded (i.e., divisible into units that can be allocated to more than one processor). This situation should change once Windows NT becomes established, since NT supports distribution of multithreaded applications over multiple processors. And NT will be similar enough to Windows to make multithreaded rewrites of key Windows applications, such as Excel, feasible.

continued

Hands On Under the Hood



NetFrame Systems' asymmetric architecture uses one CPU to run the network operating system while dedicated processors handle I/O tasks. The main CPU bus connects via custom ASIC bus controllers to MPSA buses, each of which can support two dedicated processor boards.

Scalability

The challenge for a shared-memory multiprocessor systems designer is to make the machine work faster as more processors are added—in other words, to achieve *scalability*. While multicomputers may approach the ideal of linear scalability, where twice as many CPUs give twice the throughput, shared-memory machines fall far short of this ideal: Adding a second processor increases throughput often by as little as 50 percent, and this number drops steeply as more processors are added, until adding an extra processor slows the system down. How soon the design reaches this point depends on the effective bandwidth of the bus connecting the processors to shared memory.

To avoid a bottleneck, a multiprocessor's memory bus must have a sustainable bandwidth that equals or exceeds the sum of the bandwidths of all the components connected to it. Sustainable bandwidth is the product of bus availability and peak bus bandwidth (i.e., how often you can get the bus, multiplied by how fast it is once you've got it).

The ISA bus, which is capable of 1.5-MBps throughput, is far too slow to serve as the memory bus even for today's uniprocessor desktop PCs, let alone for multiprocessor systems. Likewise, its 33-MBps successor, the EISA bus, has been rendered inadequate by rapid CPU evolution; a multiprocessor system using several Intel Pentium processors would need a memory-bus bandwidth measured in the hundreds of MBps.

Designers often use the EISA bus (or IBM's Micro Channel) as a supplementary I/O bus, although both are far too slow to serve as the memory bus in multiprocessor systems. Multiprocessor memory buses always support multiple mastering so that

intelligent EISA I/O devices can transfer data to and from memory without involving the CPUs. These bus-master devices contend with the CPUs for a share of the memory-bus bandwidth, which makes scalability of the I/O system another top priority for the systems designer.

Higher Bandwidth

The simplest route to obtaining a high peak bus bandwidth is to adopt a wide data path. Clocked at the 33 MHz that's typical of 486DX2-66 systems, a nonmultiplexed 64-bit bus—one with separate data and address lines—can carry a peak load of 267 MBps (33 million × 8 bytes). Electrical constraints place a performance ceiling on PCB-based (printed circuit board) buses, and to go much faster you have to move up to transmission-line technologies such as Apple's 350-MBps QuickRing (see "Fast Transit," October 1992 BYTE). However, further improvements to this theoretical peak bandwidth can come from splitting the bus into multiple parallel data paths.

The biggest boost to bus availability comes from large and efficient CPU caches, which can shield the bus from up to 90 percent of CPU traffic. While one CPU or I/O bus master has control of the bus for a lengthy transaction, the other

CPUs can continue running at full speed from their caches.

A designer can also make the bus more available by increasing its internal concurrency and by distributing its workload more evenly. For example, separating the lines that carry bus-arbitration signals from the data lines enables arbitration to take place concurrently with data transfer—in effect costing nothing in terms of performance. *Bus parking*, another optimization, lets a bus owner keep the bus without arbitration if no one else has requested it. This speeds up burst transfers. A multiprocessor interrupt scheme should allow all the CPUs to interrupt each other for efficient arbitration, and I/O interrupts should be routable to any CPU to avoid swamping one CPU.

The new Intel 82489DX APIC (Advanced Programmable Interrupt Controller) multiprocessor fulfills both of these requirements by automatically routing interrupts to the least-busy or lowest-priority processor. The APIC will soon replace the old 8259A (used in all PC compatibles since the original PC), which is slow and has no internal multiprocessor support.

The Write-Back Cache

Today's high-performance microprocessors all contain an onchip cache, but multiprocessor systems designers always supplement this with an external or secondary SRAM (static RAM) cache, which runs at the full bus speed of up to 40 MHz. The cache gets filled from memory in large (often 32-byte) chunks, or lines, using the CPU's burst-transfer mode. To simplify both PCB design and user upgrading, vendors segregate these fast circuits onto small, separate CPU-cache modules, which you can plug into a passive bus backplane.

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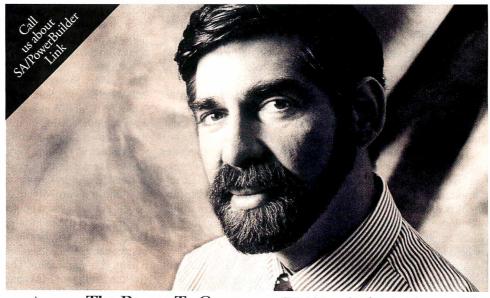
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Hands On Under the Hood

Caching a multiprocessor system raises tricky cache-coherency issues. For example, since several CPUs may hold a copy of the same variable in cache memory and since all of them may have modified its value, which is the correct value? The easiest way to maintain coherency is through a write-through cache design: Whenever a CPU writes to a cache line, the system immediately updates the value in main memory, too—the data is written through the cache.

Your desktop PC's cache is almost certainly a write-through design. Though easy to implement, such a design is inefficient in a multiprocessor system because it involves a main-memory access every time that a value changes. That soon saturates the bus and makes scalability beyond two processors impractical.

Instead, multiprocessor systems adopt the more difficult writeback technique, which writes modified data to main memory only when it's absolutely necessary. Unfortunately, this technique requires a complex scheme to maintain coherency.

The *write-invalidate* coherency protocol is fast becoming the standard for multiprocessor caches. It marks the state of every cache line (using 2 extra bits in the cache tag) as modified, exclusive, shared, or invalid. For this reason, the write-invalidate protocol is also called MESI. Each processor's cache controller monitors all bus activity, a task known as *bus snooping*, looking for attempts by other devices to read memory locations currently held in its cache.

A processor can write to any line that is exclusive (i.e., not held in any other cache). The controller then marks the line as modified, but it does *not* write it back to main memory. If the bussnooping controller discovers another processor requesting the now-out-of-date value from main memory, the controller traps the read attempt, places its own modified data on the bus to satisfy the request, and marks the line as shared—again without accessing main memory. A processor is not allowed to write to a shared line. Instead it must broadcast to all other caches holding that line, telling them to mark their copies as invalid (i.e., they must be reread from memory). The line then becomes exclusive again.

Under the MESI protocol, most processor reads and writes go to each CPU's local cache or between CPU caches, and the system updates stale values in main memory only when a cache is

flushed. A write-back cache design is particularly effective when the interprocessor and memory buses are separated, as in Compaq's Triflex architecture (described below). This allows I/O bus masters to access main memory concurrently with the inter-CPU activity.

Symmetric vs. Asymmetric

Shared-memory multiprocessor systems fall into symmetric and asymmetric varieties. Symmetric systems treat all CPUs equally: Any processor is available to perform any task. Asymmetric designs dedicate each CPU to a specific task.

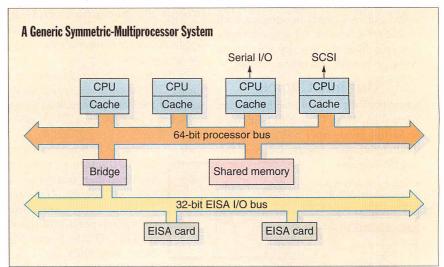
Each processor in a symmetric-multiprocessor system has equal access to I/O devices and main memory. All the CPUs cooperate in running a single stream of code; all run the operating system and application code concurrently. Any processor can perform any operating-system service, such as file access or memory allocation, so operating systems for symmetric-multiprocessor machines must be multithreaded right down to the kernel and the device-driver level. They must also provide secure locking mechanisms so that a CPU can lock onto the thread it is currently executing to prevent other CPUs from interfering with it (see "A Fearful Symmetry," May 1990 BYTE). This is necessary for critical sections of operating-system code that perform indivisible operations.

Such operating systems allocate new tasks to whatever processors are free by using a priority queuing system. Operating systems with these symmetric-multiprocessing features include SCO Unix System V release 3.2 with MPX (multiprocessor extensions), Unix System Laboratories' Unix System V release 4.0 MP V2, SunSoft's Solaris 2.0, the Mach-based NextStep, Banyan Vines SMP, and Windows NT. Many vendors also offer proprietary multiprocessing modifications to NetWare, and Novell will offer its own solution soon.

Symmetric systems vary in their degree of symmetry. Machines like the Tricord PowerFrame mix symmetric processors with dedicated I/O processors, while some older designs such as Compaq's Flex/MP are computationally symmetric but allow only the processor that booted the system to service I/O interrupts.

An asymmetric-multiprocessor system devotes each processor to a particular task. Normally, one processor runs the operating-system kernel while the rest service disk drives or networks or run a particular application. These dedicated I/O processors behave like the intelligent I/O channels in mainframe computers, which feed the CPU and main-memory data without bus contention.

Asymmetry confers several economic advantages. An asymmetric machine can run a conventional network operating system like NetWare 3.11 or LAN Manager. Since vendors don't have to wait for a multiprocessor port of the operating system or modify their application code, they can get usable applications to market faster. A systems designer can also tailor the cost and power of each CPU to its own task. But an asymmetric machine is good only for the job for which it's designed, usually as a file or database server. In contrast, a symmetric machine has the potential to fulfill any role (assuming application support is available).

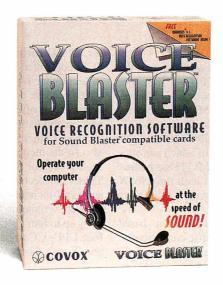


A symmetric-multiprocessor system distributes workload evenly between processors, each of which has equal access to I/O devices and main memory. Here, a 64-bit processor-to-memory bus connects processor/cache modules to the EISA I/O bus via a bridge.

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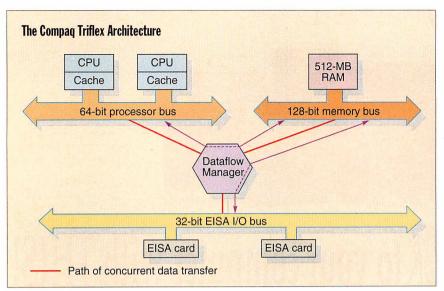
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Hands On Under the Hood



Compaq's symmetric Triflex architecture uses both an interprocessor bus and a memory bus and connects both to the EISA I/O bus by way of Compaq's custom Dataflow Manager chip. This chip allows processors to access main memory concurrently with EISA bus-master devices more than 70 percent of the time.

Asymmetry in Action

An impressive example of a wholly asymmetric architecture is the NetFrame Systems design. It uses a single CPU—a 386, 486, or (as is planned) Pentium—that runs NetWare or LAN Manager from a main memory consisting of up to 256 MB. The main CPU bus connects via custom ASIC (application-specific IC) bus controllers to two or four I/O channels called MPSA (Multiprocessor System Architecture) buses, each of which can support two dedicated peripheral processor boards. These boards contain either Intel 376 (used in conjunction with the 386SX family) I/O processors or 50-MHz 486 application processors fitted with 4 to 128 MB of local memory.

All these peripheral processors can access the main shared memory, and the MPSA buses handle this traffic concurrently, with essentially zero contention. Each peripheral processor can handle 12.5 MBps, yielding a total I/O bandwidth of 100 MBps from four fully configured MPSA buses. That precisely matches the bandwidth of the 64-bit memory bus.

Multiple I/O buses provide a high degree of fault tolerance, and the NetFrame architecture also includes an Intel 80188 service processor that monitors system integrity (e.g., bus parity checking, ECC [error-correction code] memory correction, power supplies, and disk mirroring), permitting mainframe-style remote diagnosis and maintenance via a modem and telephone line.

Symmetric-System Architecture

The dual-bus architecture in the figure "A Generic Symmetric Multiprocessor System" could describe many of today's symmetric-multiprocessor systems. A 64-bit processor-to-memory bus accepts plug-in processor/cache modules and is bridged to an industry-standard (usually EISA) I/O bus that accepts off-the-shelf network and disk controllers or other I/O cards. The bridging circuitry might be based on Intel's 82350 EISA chip set or a special ASIC designed by the system vendor. The system design usually implements basic PC motherboard functions such as keyboard and floppy disk support and VGA video.

This basic architecture was pioneered by Corollary, whose C-

Bus and XM multiprocessor board sets have been licensed by many OEMs. Corollary also helped develop the multiprocessing code for SCO MPX. Its latest-generation C-Bus II is a multiplexed 64-bit bus with a 267-MBps peak transfer rate, a 32-GB address space, and support for up to 14 CPUs. C-Bus processor boards may contain private I/O subsystems (e.g., SCSI-2); this lets the designer build mixed symmetric/asymmetric systems. Corollary is also developing an implementation of C-Bus II, called SIMPL, for Intel's Pentium.

Tricord's PowerFrame architecture is similar. Its proprietary 32-bit PowerBus reads its interleaved memory 128 bits at a time, giving a sustained bandwidth of 132 MBps or a burst rate of 267 MBps. The seven-slot PowerBus backplane accepts up to four symmetric 486DX2-66 CPU boards or up to six asymmetric I/O boards, called Intelligent SCSI Subsystems (ISSes). These bus-master boards each contain a 33-MHz 386SX I/O proces-

sor, an I/O cache, disk-handling firmware in ROM, and four SCSI controllers that can support up to 28 SCSI devices. The ISSes provide I/O transfer rates that are two to three times faster than those you'd get with the EISA bus. Like the NetFrame, the PowerFrame offers mainframe-style system management, diagnostics, and fault-tolerance features.

Several other symmetric-multiprocessor architectures would also fit the model shown in the figure "A Generic Symmetric-Multiprocessor System" if you eliminated the asymmetric I/O. These architectures include AST Research's Manhattan SMP and its 64-bit nonmultiplexed Cupid-MPx bus (which can support up to six symmetric 486 CPUs), Olivetti's 64-bit OLIBus 4 (supports up to four CPUs), Acer/Altos's 64-bit FrameBus (supports four CPUs), Compaq's 32-bit Flex/MP (supports two CPUs), and Wyse's 64-bit Wyde Bus (supports three CPUs).

Split Bus

Compaq's new generation of Systempro/XL servers introduces the radical Triflex architecture, which increases concurrency by splitting the processor bus (see the figure "The Compaq Triflex Architecture"). Unlike Compaq's older Flex/MP, Triflex is now fully symmetrical, with I/O interrupts equally distributed among the processors. Triflex features a 64-bit interprocessor bus and a 128-bit memory bus, both connected to the EISA I/O bus by way of Compaq's custom Dataflow Manager chip. This chip contains multistage 256-bit buffers that can cache up to 16 EISA transfers or up to four processor transfers. This allows the processors to access main memory concurrently with EISA bus-master devices more than 70 percent of the time. Compaq claims Triflex has the same peak bandwidth (267 MBps) as other vendors' designs, but the extra concurrency should give it an edge in I/O-bound applications.

Compaq's new 64-bit ServerCache-2 snooping cache controller is designed specifically to exploit the Intel Pentium and its successors. Although the recently launched Systempro/XLs still offer only two 50-MHz 486 processors, it's no secret that future Triflex models will support up to four Pentiums.

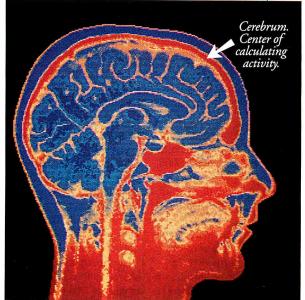
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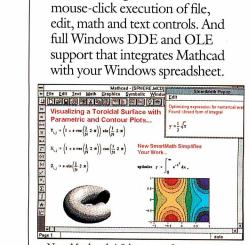
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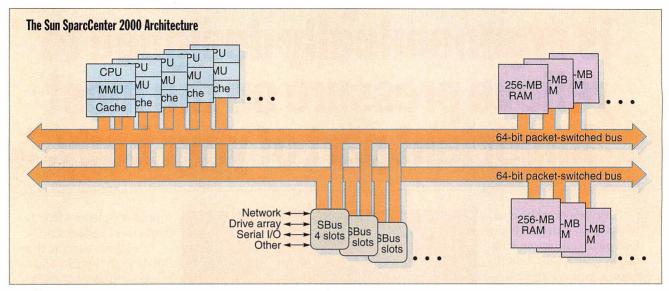
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Hands On Under the Hood



Sun Microsystems' SparcCenter 2000 uses two parallel packet-switched memory buses to double I/O bandwidth. The packet-switched architecture allows Sun to split the request/reply cycle into two transactions. While one processor waits for a reply, other processors can access the bus.

Split Transactions

One alternative multiprocessor bus design provides two parallel memory buses to double the bus bandwidth. NCR's System 3000, for example, uses twin 64-bit buses that each carry two or four 486 CPUs and use a dual-ported shared memory. Using this design, the System 3000 achieves a peak bandwidth of 400 MBps (225 MBps sustained).

Sun Microsystems' flagship multiprocessor, the SparcCenter 2000, follows the same route but uses *packet-switched* memory buses. All the multiprocessor systems I've described so far—and indeed, most computers—use *circuit-switched* buses, on which transactions are atomic, or indivisible, operations. Here, a requesting device arbitrates for the bus, gets control, places a target address on the bus, and then keeps control while it transfers the data to or from that address. For the duration of this transaction, other processors are denied bus access. Unfortunately, much of this time is wasted in nonbus activities like waiting for a RAM chip to deliver its data.

When a packet-switched bus is present, a device arbitrates for the bus, gets control, sends a request packet containing the target address, and then releases the bus. Later, the requester receives a reply packet on the bus. Under this asynchronous bus protocol, requests may be separated from replies by any number of other packets—hence the term *split transactions*.

Although it is more complex to implement, packet switching offers great benefits. It maximizes bus throughput by keeping the bus full of packets. It accommodates slow devices connected to the bus without compromising overall performance. And small, fixed-size packets guarantee short transactions, so you can adopt a simple nonpreemptive arbitration scheme. For example, the SparcCenter implements interrupts as packets, which are carried on the main bus.

The SparcCenter uses a parallel pair of 64-bit XDBuses (originally developed by Xerox), with memory addresses interleaved between the pair on 256-byte boundaries to give the effect of a single 128-bit bus. Its fault-tolerant design allows the system to remain operational should one bus fail, but with only half the bandwidth, shared memory space, and cache. Each XDBus has a peak

bandwidth of 320 MBps, and the sustained bandwidth is proportionally high at 250 MBps, which allows for 500 MBps of total sustainable bandwidth.

The SparcCenter can handle up to 20 SuperSparc processor modules, each holding a 40-MHz CPU, 1 MB of secondary cache, an MMU (memory management unit), and a SuperCache snooping cache controller chip. The latter offers three alternative write-back coherency protocols, which are selectable in software and optimized for different types of workloads: write-invalidate; write-broadcast, which is more efficient when many lines are shared; and competitive caching, a heuristic compromise between the first two.

You can expand the shared memory to 5 GB, and a programmable address space enables dynamic reconfiguration to fill "holes" in the memory map. I/O is provided by up to 10 of Sun's proprietary SBuses, each of which has four 50-MBps slots for SparcStation-compatible I/O cards.

Mainframe Challenge

It's difficult to verify vendors' scalability claims for their multiprocessor system designs, but vendors' figures suggest that CPU scalability was rather poor for first-generation symmetric machines (50 percent or less for a second processor). Right now, asymmetric and mixed symmetric/asymmetric architectures like the NetFrame and Tricord PowerFrame are probably the most cost-effective solutions for general file-serving applications. However, the more advanced architectures described here, together with improved operating-system support, promise realizable performance increases from up to four CPUs—more for the SparcCenter.

For most of the past decade, PC enthusiasts have been prematurely promising the death of the mainframe. But these new microprocessor-based architectures, when combined with new mass-storage devices like erasable optical disks, just might make good on that promise.

Dick Pountain is a BYTE consulting editor based in London. You can contact him on BIX as "dickp."

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function/principal area of responsibility? (Check one) 1 D MIS/DIP

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4 A Sales/Marketing 5 Engineer/Scientist

B. What is your level of management responsibility?

8 Middle-level

C. Are you a reseller (VAR, VAD,

Dealer, Consultant)?

Security

June 1993

12 PC/MS-DOS

14 D OS/2

or software?

19 26-50

13 D DOS + Windows

E. For how many people do you

influence the purchase of hardware

43

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21 🗖 100 or more

20 🗆 51-99

16 MacOS

17 VAX/VMS

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Circle the numbers below for information on the entire category of products you're interested in.

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Add-in Boards	
Bar Coding	
Communications/Networking	
Computer Systems	
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Monitors & Terminals

Programmable Hardware Scanners/OCR/Digitizers Tape Drives 11 UPS 12 Software 13 Business CAD/CAM Communications/Networking 27 **Data Acquisition** 17 Database

Multimedia

Printers/Plotters

Educational 20 Engineering/Scientific 21 Entertainment Graphics Mail Order Mathematical/Statistical Miscellaneous Software 25 On-Line Services 26 Operating Systems

Shareware 31 Software Duplication 32 Spreadsheets Unix Utilities Windows Word Processing 37 Genera 38 Books/Publications Recruitment Programming Languages/ Miscellaneous

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	782	808	834	860	886
	783	809	835	861	887
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Inquiry Numbers 1123-1304

1123	1149	1175	1201	1227	1253	1279
1124	1150	1176	1202	1228	1254	1280
1125	1151	1177	1203	1229	1255	1281
1126	1152	1178	1204	1230	1256	1282
1127	1153	1179	1205	1231	1257	1283
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1129	1155	1181	1207	1233	1259	1285
1130	1156	1182	1208	1234	1260	1286
1131	1157	1183	1209	1235	1261	1287
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1142	1168	1194	1220	1246	1272	1298
1143	1169	1195	1221	1247	1273	1299
1144	1170	1196	1222	1248	1274	1300
1145	1171	1197	1223	1249	1275	1301
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953	978	1003	1028	1053	1078	1103
954	979	1004	1029	1054	1079	1104
955	980	1005	1030	1055	1080	1105
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Inquiry Numbers 1305-1479

1305	1330	1355	1380	1405	1430	1455
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1312	1337	1362	1387	1412	1437	1462
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1314	1339	1364	1389	1414	1439	1464
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IBM Unleashes a New OS/2

Like PC-DOS 2.1, OS/2 2.1 could become a rock-solid winner



BARRY NANCE

Remember PC-DOS 2.1? Its features and reliability were exactly what most users needed—so much so that many people stuck with it when newer ver-

sions came to market. IBM and many OS/2 users would like history to repeat itself with OS/2 2.1. While it's not perfect, OS/2 2.1's overall quality and new features may well earn it the same reputation as its DOS counterpart.

The IBM OS/2-support forums are CompuServe's busiest areas. People talk about the unwieldy number of installation disks, the sluggishness of Windows under OS/2 2.0, the need to run Windows software in enhanced mode, the lack of video drivers, the wish for more and faster printer drivers, the desire to run OS/2 on laptops and notebooks, and the dream of running CPU-interrupt-intensive multimedia software on OS/2. Version 2.1 resolves all these issues.

You can install OS/2 2.1 from CDs or floppy disks, and you can install portions of it on different logical drives. Version 2.1 supports Hitachi, IBM, NEC, Panasonic, Sony, Texel, and Toshiba CD-ROM drives connected through Adaptec, Distributed Processing Technology, Future Domain, and IBM SCSI controllers. It includes MSCDEX support in each DOS session via the VCDROM virtual device driver, and VCDROM lets MSCDEX-aware DOS and Windows multimedia applications process both audio and digital data concurrently.

Multimedia Supported Here

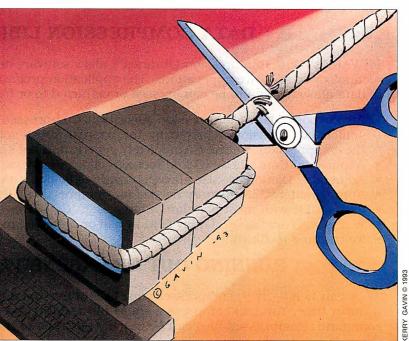
OS/2 now includes built-in multimedia support, in the form of MMPM/2 1.01. To allow DOS multimedia programs to run well in a DOS session, IBM has added *dual-thread DOS-session support*. As a multimedia-based program reads from or writes to a disk file, the program needs to service sound-card interrupts on a timely basis. In effect, dual-thread support lets DOS appli-

cations run concurrently along two threads in a single DOS session. The second processing thread within the session lets the program handle sound-card interrupts while file read or write operations occur. Support is automatic; the DOS program doesn't have to do anything. The OS/2 settings notebook entry for a DOS session, INT DURING IO, enables the dual-thread feature.

Multimedia isn't the only software that must service interrupts during file read and write operations. You can use INT_DURING_IO to accelerate the uploads and downloads you do with a DOS communications program. IBM also rewrote the VCOM.SYS serial-port handler, making it smarter and faster, to help DOS communications programs perform better.

Some of the biggest changes are in OS/2's WINOS2 (Windows within OS/2) area, which runs Windows 2.x, 3.0, and 3.1 applications, full-screen or on the OS/2 desktop. OS/2 runs Windows programs faster than DOS does. A Windows 3.1 session can run in enhanced or standard mode, and you can have several sessions. (You can't yet run Win32s or extended Windows applications, but support for Win32s applications may appear later this year.)

You can configure DDE and the Clipboard to operate in public mode, where PM (Presentation Manager) software can share data with Windows software through a global Clipboard, or in private mode. Windows 3.1 under OS/2 uses TrueType fonts, includes new printer dri-



vers, offers OLE support, and uses the same display resolution as the OS/2 desktop.

OS/2 Acceleration

IBM's programmers used a variety of techniques to speed up Windows sessions and OS/2. IBM calls one technique *page tuning*. Each time IBM programmers installed new code in the operating system, performance experts used software- and hardware-monitoring tools to profile code

Hands On Beyond DOS

execution frequency and memory utilization. Because 16- and 24-bit ICEs (in-circuit emulators) weren't up to the task, IBM developed a 32-bit ICE called RTS (Real-Time Tracing System) to monitor OS/2's behavior. The programmers used this information to optimize and tune OS/2.

The process of page tuning is highly iterative. Each build of the operating system was followed by a detailed analysis of how the system behaves in a variety of situations, with each situation involving a given mixture of applications software activity and Workplace Shell activity on different hardware platforms.

I was amazed to discover that IBM used the Watcom C compiler, not the Microsoft C compiler, to compile the Windows components of OS/2. John Sierra, manager of OS/2 Systems Performance at IBM, says that the speed improvements in WINOS2 and in OS/2 were the result of a combination of factors: choosing the appropriate compiler, analyzing the page-tuning statistics, and simply using common sense and creative programming techniques to optimize the code. Using the Watcom C compiler was a low-risk way to speed up WINOS2.

IBM used its own 32-bit C Set/2 compiler for the base operating system, the 32-bit graphics engine, and many other parts of OS/2. Performance experts claim that the C Set/2 compiler lends itself nicely to the page-tuning process, letting programmers easily control and manage code tuning. The judicious use of assembly language in some modules accounts for further performance gains. IBM uses an internal version of MASM (Microsoft Macro

Assembler) 5.1 to produce object code for these modules.

IBM is in the process of producing the manual *OS/2 2.1 Performance Tuning for End Users*, which should be available soon after you read this. I found my alpha copy of it quite useful.

Windows Reworked

You can now start DOS and even OS/2 sessions from within a Windows session running within OS/2. IBM also rewrote the Windows Clipboard and the DDE and OLE modules to make them faster and more reliable. (PMCLIP.DLL, PMDDE.DLL, and VWIN.SYS replace CLIPOS2.EXE, DEEAGENT.EXE, and VDMSERVER.EXE, respectively.) The Clipboard now uses a form of shared memory, rather than named pipes, to transfer data. And since both DDE and OLE pass through the Clipboard, this speeds things up considerably.

IBM uses a technique called *virtual clipboard rendering* to postpone the rendering of Clipboard data until paste time. VWIN doesn't have to convert Clipboard data into every possible format. Instead, VWIN.SYS looks at paste time for the requested format and renders in just that format.

You get the usual accessories that are found in Windows 3.1, including the following: Sound Recorder, Character Map, Media Player, Calculator, Calendar, Cardfile, Notepad, Object Packager, Paintbrush, and Windows Write. The Windows 3.1 File Manager and Print Manager are there, if you prefer to manage your computer through Windows. IBM also includes the system

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Hands On Beyond DOS

diagnostic tools MSD.EXE and DRWATSON.EXE.

OS/2's memory management environment within DOS sessions includes DPMI (DOS Protected Mode Interface) 1.0. OS/2 previously supported DPMI 0.9. The DPMI support lets OS/2 run programs like AutoCAD.

The Driver Issue

The biggest complaint about OS/2 2.0 was the dearth of high-resolution video drivers. OS/2 now supports seven Super VGA chip sets in 800- by 600-pixel or 1024- by 768-pixel modes with 256 colors. The seven chip sets are ATI Technologies' VGA Wonder XL; Headland Technology's Video Seven HT209; Trident Microsystems' 8900; Tseng Laboratories' ET4000; Western Digital's Paradise WD90C00, C11, C30, and C31; Cirrus Logic's CL-GD542X; and IBM's 256c Super VGA chip. The drivers for VGA, XGA (Extended Graphics Array), 8514/A, and Super VGA are all 32-bit code.

You may even see seamless 8514/A and S3 Windows support in OS/2 2.1. IBM has written and was testing the code at press time.

IBM has optimized OS/2's 32-bit graphics engine. Its programmers replaced much of the graphics engine with faster code and used the 32-bit C Set/2 compiler to produce the DLLs and device drivers that make up the graphics engine. During the pagetuning effort, the programmers gave special emphasis to the Workplace Shell and graphics-intensive applications software.

OS/2 2.1 contains new and enhanced printer drivers. IBM programmers tuned and reworked both the printer drivers and the parallel-port device drivers to speed printing. OS/2 supports laptops and notebooks through APM (Advanced Power Management) and PCMCIA drivers. If your notebook is APM-aware, OS/2 will coordinate with its power-conservation features to make your battery last longer. You can double-click on the APM icon in the System Setup folder to see how much battery power remains or to turn power management functions on and off.

The Next Step

OS/2 2.1 isn't perfect. You still must boot up two installation disks to run CHKDSK against your OS/2 boot-up partition. A CONFIG.SYS editor doesn't yet exist. And 4 MB isn't really enough RAM to run OS/2. But IBM says it's working on these and other issues.

In the future, look for IBM to reduce the memory and disk space requirements for OS/2. IBM programmers will continue to work on the 32-bit graphics engine and WINOS2, page tuning as they go. IBM will develop more device drivers for more kinds of video, disk, and other adapters. You'll see many of the device drivers and enhancements appear as downloadable files in IBM's support area on CompuServe. Look for IBM to provide OS/2 migration paths to the PowerPC, IBM RS/6000, and other computers later this year or early next year. You'll also see the Workplace Shell user interface on more computers.

In the meantime, I'm using a native OS/2 word processor under OS/2 2.1, with 1024- by 768-pixel resolution, to write this. I'm downloading a file with my modem. And I'm compiling a program in yet another session. ■

Barry Nance is a contributing editor for BYTE. He is the author of Using OS/2 2.1 Special Edition (Que, 1993), and Networking Windows for Workgroups (Wiley, 1993). He is the editor for the IBM Exchange on BIX, where you can reach him as "barryn."

Animation for Windows Applications

Use this C++ class to add movement to your Windows programs



MICHAEL J. YOUNG

The ability to move a small image or sprite within a window, independently of the background graphics, can be useful in numerous types of programs, in-

cluding computer games, tutorials, demos, and simulations. Even if you're not writing one of these special types of programs, you will find this ability to be useful for adding drag-and-drop capability to your Windows applications.

A C++ class is an ideal medium for encapsulating the data and functions needed to create animation. The C++ class CSprite lets you move a figure of any size or shape across a window containing any pattern of text or graphics. The class is designed to generate smooth, flicker-free animation.

BOOL Initialize (HBITMAP HMask, HBITMAP HImage);

You pass the handles for the mask and image bit maps, which define the figure that you want to animate. In the mask bit map, the figure appears as black on a white background; the image bit map contains the normal color figure on a black background. When displayed, the figure appears in color, but the background is invisible. Only the X appears, surrounded by the existing screen graphics.

The easiest way to create the bit maps is to design them using a bit-map editor or drawing program such as Windows Paintbrush, save them in separate files, and incorporate them as program resources by means of BITMAP statements within the program's resource-definition file. You can then load the bit maps and assign

Using the Class

To use the CSprite class, you would include the class header file SPRITE.H (see page 200) in your C++ source code and then link your program with the compiled version of the class implementation file, SPRITE.CPP. If you are using Microsoft C/C++ or Borland C++, you simply include SPRITE.CPP in the project file for your Windows program.

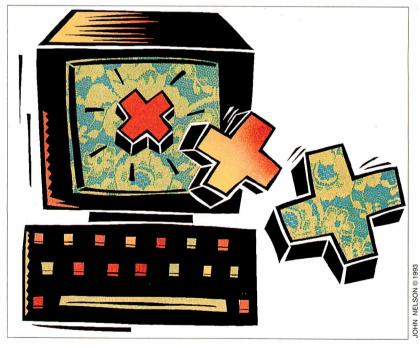
To create an object for animating an image, you can declare an instance of CSprite or use the new operator:

CSprite *PCSprite;
PCSprite = new CSprite;

You can increase the efficiency of the animation by specifying the CS_BYTEALIGN-CLIENT class style when you register your window class. This style allows the CSprite class to transfer blocks of graphics that begin on even byte boundaries, generating faster transfers.

Once you've produced an instance of CSprite, you can use the public member functions of this class to generate an animation sequence. I declared these functions in the CSprite class definition within the SPRITE.H header file. Note that all the member functions except Get-Coord return TRUE if successful or FALSE if an error occurs.

Before you use any other member function, you will need to call Initialize, which has the following format:



them to the CSprite object using statements such as these in the program source code:

HBITMAP HImage;
HBITMAP HMask;
HMask = LoadBitmap (HInstCurrent,
 "Mask");
HImage = LoadBitmap (HInstCurrent,
 "Image");
Sprite.Initialize (HMask, HImage);

Hands On Some Assembly Required

Before your program exits, call Delete-Object to delete the two bit maps—neither Windows nor the CSprite class deletes them for you. If you later want to use the same CSprite object to animate another figure, you can call Initialize again, passing it the handles for different bit maps.

To display the object at its initial position and start an animation sequence, call the member function BOOL Start (HDC HDc, int X, int Y);, where HDc is the handle of the device context in which you want to display the image, and X and Y are the horizontal and vertical coordinates of the upper left corner of the area where you want the image displayed. Start saves the current graphics underlying the position where the image will appear and

then draws the image at the specified coordinates. The following code displays an image at the upper left corner of the window:

HDC HWinDC; HWinDC = GetDC (HWnd); // HWnd contains the window handle Sprite.Start (HWinDC, 0, 0); ReleaseDC (HWnd, HWinDC);

Note that the device context you specify when calling Start (or any other CSprite member function that receives a device context handle) must be in the MM_TEXT mapping mode, which is the default.

To move the object to each subsequent position in the animation sequence, call MoveTo, which has the following form:

BOOL MoveTo (HDC HDc, int X, int Y);

A C++ class is an ideal way to encapsulate the data and functions that you'll need to create smooth, flicker-free animation.

restores the saved screen graphics at the prior image position, saves the current graphics underlying the new display position, and then draws the image at the new position. If, for example, a user is dragging the object with a mouse, the program calls

The parameters

are the same as

those passed to

Start. MoveTo

MoveTo in response to each WM_MOUSEMOVE message to transfer the image to the current mouse-cursor position.

If you want to redraw the image at its current position (i.e., at the position specified in the most recent call to Start or Move-To), you can invoke the call BOOL Redraw (HDC HDc); . The Redraw function, which draws the image without saving or restoring screen graphics, is useful for restoring the image at its

MASK AND EDIT BIT MAPS

The combined mask and image bitmap images allow animation to occur while preserving the background image (see the screen "Animation Demo 1").





current position when redrawing the screen in response to a WM_PAINT message.

To erase the image, call BOOL Hide (HDC HDc); . The Hide function restores the saved screen graphics, erasing the image. The CSprite class saves the current position; you can call Redraw to view the object again.

Finally, you can obtain the current coordinates of the image by passing the address of a RECT structure to GetCoord, which takes the

void GetCoord (RECT *Rect);

GetCoord assigns the coordinates for the upper left corner of the image to the structure's left and top fields, and it assigns the co-

ordinates of the lower right corner of the image to the right and bottom fields. If you call GetCoord after calling Initialize but before calling Start, the top and left field values will be 0 and the right and bottom fields will contain the image width and height (i.e., the dimensions of the bit map used to create the im-

Sample Programs

I wrote two sample programs, DEMO1 and DEMO2, that use the CSprite class to animate an X-shaped image, 52 pixels wide by 61 pixels high. In DEMO1, you move the image by pressing an arrow key or by dragging it with the mouse. In DEMO2, the image moves automatically in a continuous circular path. Both programs display a checkered background to demonstrate that you can move the image over the background without disturbing the existing window graphics.

I used several techniques in DEMO1. I declared the CSprite instance Sprite as a global object. After creating the main program window, the initialization routine loads the bit maps and calls CSprite::Initialize to initialize the object. On the first WM_PAINT message, the message-handling routine calls Start to position the image in the middle of the screen; on subsequent messages, the routine calls Redraw to restore the image at its current position. These functions are called after the messagehandling function draws the window background.

When the user presses an arrow key, the WM_KEYDOWN message handler calls GetCoord to obtain the current image position and calls MoveTo to move the image 4 pixels in the appropriate direction. When the user drags the image, the WM_MOUSEMOVE message handler calls MoveTo to move the image to each new mouse-cursor position.

DEMO2 works the same way, but to move the image automatically, it calls the Windows API function SetTimer to start a Windows timer. This function causes Windows to send a series of WM_TIMER messages, with a specified time duration between each message. On the first WM_TIMER message, DEMO2 calls Start to position the image at the starting point along its circular path. On each subsequent message, it calls MoveTo to move the image to the next position along the circle (it uses the C++ library functions sin and cos to calculate the coordinates for each point on the circle).

To make the automatic movement of an image as smooth as possible, set the duration of the timer to the lowest possible value. Note that as you assign smaller values to the uTimeout parameter

Hands On Some Assembly Required

passed to SetTimer, the time between WM_TIMER messages decreases; eventually, you reach a point where, because of the time overhead required to send and process the messages, passing smaller values does not decrease the actual time between these messages. The constant PERIOD contains the duration assigned to the uTimeout parameter.

You should then adjust the amount of movement on each WM_TIMER message to achieve the desired object speed. In DEMO2, I use the constant DEL/TATHETA to determine the amount of movement. The constant is the value added, on each timer message, to the subtended angle that determines the position of the image on the circle.

In Animation Demo 1, the image bit map creates the X; a mask bit map preserves the

object movements by repeatedly calling across the screen.

MoveTo during the processing of a single message, rather than moving it each time the program receives a timer message. However, this practice blocks Windows message processing, which means that the user cannot enter commands or do task-switching.

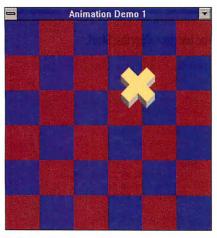
How CSprite Works

The CSprite class has several member functions. Initialize uses the Windows API function GetObject to obtain the sizes of the mask and image bit maps that it receives (it returns an error code if the bit maps are not the same size). It then calls the API function CreateCompatibleBitmap to create a new bit map that is the same size as the mask and image bit maps. It uses this bit map to save the underlying screen graphics when it displays the sprite. Its handle is saved in the private data member mHSave. Initialize also saves mask and image bit-map handles.

Start calls the Windows API function BitBlt to save the underlying screen graphics in the mHSave bit map, passing it the raster-operation code SRCCOPY to perform a simple copy operation. It then uses BitBlt to draw the screen image (see the CSprite::Start listing). Bit transfers are much faster than

calling individual drawing functions, and you can easily create a complex drawing using a bit-map editor and simply load and copy the bit map to the window.

Unfortunately, BitBlt always transfers a rectangular block of graphics, so it overwrites the existing background when handling nonrectangular images. That's why I used two bit maps. When Start calls BitBlt to transfer the mask bit map, it assigns the value SRCAND to the raster code parameter. BitBlt then combines the bits in the bit map with the existing bits on the screen using the AND operator. Because the background within the mask bit map is white (all 1s), the existing screen graphics in the background area are unaltered. And because the figure within the mask bit map is black (all 0s), the resulting figure on the screen is also black.



termines the position of the image on e circle.

You could increase the frequency of checkerboard background as the image moves across the screen.

When Start then calls BitBlt to transfer the image bit map, it specifies the SRCIN-VERT raster-operation code, which tells BitBlt to combine the bits in the bit map with the existing bits on the screen using XOR. Because the background within the image bit map is completely black, the existing screen graphics are again unaltered. However, because the existing figure on the screen is all black (due to the previous BitBlt call), the colors within the figure portion of the bit map are copied to the screen without alteration

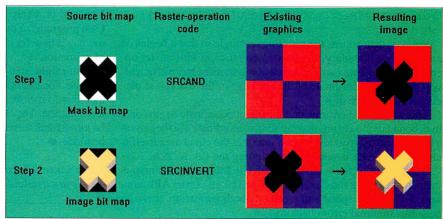
The final result is that the nonrectangular figure within the image bit map is transferred to the screen without disturbing the existing screen graphics surrounding the figure. (This is essentially the same method that Windows uses to draw icons.) After the image has successfully been drawn at its initial location,

Start saves the image coordinates in the private data members $\mathtt{m}\mathtt{X}$ and $\mathtt{m}\mathtt{Y}.$

MoveTo begins by restoring the saved screen graphics at the previous image position. It does this by calling <code>BitBlt</code> to transfer the graphics saved in the <code>mHSave</code> bit map to the window coordinates stored in <code>mX</code> and <code>mY</code>, specifying the <code>SRCCOPY</code> raster-operation code. It then saves the screen graphics at the new position and transfers the image to this position.

If, however, MoveTo were to restore the previous graphics and then draw the new graphics directly on the screen, an annoying flicker would result as the image first disappeared completely and then reappeared. To prevent flicker, MoveTo first copies the entire affected portion of the window to a temporary bit map and then performs all the bit operations within the temporary bit map. When the bit manipulations are complete, it copies the temporary bit map to the screen. Only a single bit transfer is visible, which greatly minimizes flicker.

The temporary bit map has to be large enough to hold the entire affected screen area. The affected area is the smallest rectangle that bounds both the prior image coordinates and the new image coordinates. The coordinates of this rectangle are obtained



The final result: BitBlt transfers only rectangular blocks and so tends to overwrite the background around nonrectangular objects. By assigning the raster-operation code value SRCAND to the mask bit map and SRCINVERT to the image bit map, the program cancels out the background colors, and the original background appears unaltered.

Hands On Some Assembly Required

The CSprite header file SPRITE.H.

```
class CSprite
   int mHeight;
   HBITMAP mHImage;
  HBITMAP mHMask;
   HBITMAP mHSave;
  int mWidth;
   int mX;
  int mY;
public:
  CSprite ();
  CSprite ();
   void GetCoord (RECT *Rect);
  BOOL Hide (HDC HDc);
  BOOL Initialize (HBITMAP
        HMask, HBITMAP HImage);
   BOOL MoveTo (HDC HDc,
        int X, int Y);
   BOOL Redraw (HDC HDc);
  BOOL Start (HDC HDc,
        int X, int Y);
```

using the Windows API function UnionRect:

```
URECT RectNew;
RECT RectOld;
RECT RectUnion;

RectOld.left = mX;
RectOld.top = mY;
RectOld.right = mX + mWidth;
RectOld.bottom =
    mY + mHeight;
```

```
RectNew.left = X;
RectNew.top = Y;
RectNew.right = X + mWidth;
RectNew.bottom = Y + mHeight;
```

```
UnionRect (&RectUnion, &RectOld, &RectNew);
```

MoveTo then adjusts the resulting rectangle so that it begins on an even byte boundary, to allow more efficient bit-transfer operations. (Windows can perform a block transfer more efficiently if the screen coordinate of the left edge of the block—in pixels—is a multiple of 8.)

This adjustment ensures that the client coordinate begins on a byte boundary; to ensure that the screen coordinate also begins on a byte boundary, you must make sure that the client area itself is aligned on a byte boundary by assigning the CS_BYTEALIGN-CLIENT style to the window class. The temporary bit map is then created using the CreateCompatibleBitmap API function. To increase speed and ensure smooth animation, MoveTo performs minimal error checking.

Finally, Hide uses BitBlt to copy the saved graphics in the mHSave bit map back to the current image position, thereby erasing the image. Redraw simply displays the image using the same method as Start and MoveTo, without any transfers to or from

The function CSprite::Start.

```
BOOL CSprite::Start (HDC HDc, int
X, int Y)
   HDC HMemDC:
   int Result;
   if (mHSave == 0)
     return (FALSE);
  HMemDC =
     CreateCompatibleDC (HDc);
   if (HMemDC == NULL)
      return (FALSE);
   // Save current window
   // graphics:
   SelectObject (HMemDC,
     mHSave);
   Result = BitBlt
      (HMemDC,
     0,
     mWidth,
     mHeight.
      HDc,
      Х.
      Y,
      SRCCOPY);
   if (Result == 0)
      DeleteDC (HMemDC);
      return (FALSE);
   // Display mask bit map:
   SelectObject (HMemDC,
                mHMask);
   Result = BitBlt
      (HDc,
```

```
Х,
   Υ,
   mWidth,
   mHeight,
   HMemDC,
   0,
   0,
   SRCAND);
if (Result == 0)
   DeleteDC (HMemDC);
   return (FALSE);
// Display image bit map:
SelectObject (HMemDC,
             mHImage);
Result = BitBlt
   (HDc,
   Х,
   mWidth,
   mHeight,
   HMemDC,
   SRCINVERT);
DeleteDC (HMemDC);
if (Result == 0)
   return (FALSE);
mX = X;
mY = Y;
return (TRUE);
```

the mHSave bit map.

Calling Hide and then Start would have the same overall effect as calling MoveTo, but it would result in flicker and would be less efficient than a single call to MoveTo.

Room for Improvement

You will probably think of many ways to use CSprite in your C++ programs. You can create instances of CSprite, or you can use it as a base for deriving new classes to perform specific types of animation.

You might also want to fine-tune the implementation of CSprite. For example, you might try to increase the efficiency of the MoveTo member function, which is the most performance-critical function. The faster it is, the more frequently the object can be moved and, therefore, the smoother the resulting animation can be made. ■

Editor's note: The complete listings for programs mentioned in this article are available electronically. See page 5 for details.

Michael J. Young is an author of programming books and a freelance Windows programmer in Mill Valley, California. His latest titles are Visual Basic—Game Programming for Windows (Microsoft Press, 1992) and Windows Programming with Microsoft C++ (Sybex, 1992). He can be reached on BIX c/o "editors" or on CompuServe at 75156,2572.

JERRY POURNELLE

Statistics Programs Help Businesses Work

his has been one heck of a month at Chaos Manor, what with work on a new novel and about a hundred book signings for *The Gripping Hand*. Alas, Larry Niven has back problems, so much of the publicity work fell on me, and all the travel gave me a cold.

Then there were conferences. Columnists have to go to lots of meetings and conferences. Most of them are worthwhile, and getting to major conferences is the only way I can keep up with what's new, but there are far too many. Some I like. My

favorite is the annual meeting of the AAAS (American Association for the Advancement of Science), and that was this month, too.

At AAAS I get to learn about what's new in science and technology, both discoveries and policies. It's one of the few places where I can talk to both

scientists and policymakers.

One main concern is getting more women into the sciences. That used to be a problem of removing the glass ceilings. Now it's more one of getting girls to take science and math in the sixth grade; no easy task, but if they don't do that, they're not likely to be in science later. A science career is the ultimate deferred reward.

I'm also putting together papers on another problem of science policy, reviving the X programs. Between WWII and the end of the 1960s, the U.S. built a series of experimental aircraft. The best known was the X-1, in which Chuck Yeager broke the sound barrier (and yes, that was first done by an American at Edwards Air Force Base, and no, he didn't have to reverse the controls to do it). There was also the X-15, which flew into space and returned. Less famous X-airplanes were no less successful, and the technologies developed with X-airplanes enabled American aerospace firms to dominate world markets for decades.

The X programs were canceled in the name of arms control, but now there's some interest in re-

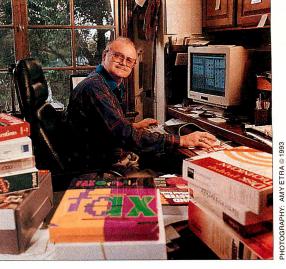
viving them. I'd very much like to see that happen, and I don't see any reason why the X concept can't be employed to develop technologies in fields other than aerospace. X programs are a way for government to assume some technological risks and yet leave actual product development to private enterprise.

All in all, it was a busy month. Meanwhile, the stuff pours into Chaos Manor.

Systems analysis was the buzzword

when I was in the aerospace business, but what I actually did was what I had learned as *operations research*, or OR. There was a close-knit fraternity of OR people, and I always thought that OR was an accurate description of what we did, even if it didn't sound as impressive as *systems analysis*.

OR grew out of WWII, when some British mathematicians and scientists applied scientific method to military and industrial activities. One of the better-known results of that was victory in the Battle of the North Atlantic, when OR people developed new tactics for the RAF and the



Most people put statistics right up there with root-canal therapy for enjoyment. With new forecasting software, it doesn't have to be that way.

Pournelle

Royal Navy, dramatically increasing the amount of cargo that got through to Britain. It incidentally showed the RAF how to sink more German U-boats.

That last sentence was deliberate: while sinking U-boats sounds more dramatic than getting cargo ships through, it wasn't the primary goal. One of the most fundamental lessons in OR is that you must choose the right criterion. If the RAF had sunk every one of the German U-boats, but the subs had sunk all the cargo ships first, Britain would have lost the war. The goal wasn't to sink U-boats but to get the cargo through, and the latter was best accomplished by making it difficult for the U-boats to attack.

OR was successfully applied to some other parts of the war effort and became a pretty glamorous field for a while. In fact, you could get graduate degrees in it, even though no one had a real good definition beyond "operations research is what OR people do." When you come down to it, that wasn't a bad operational definition, except that it wasn't always easy to describe precisely just what we did.

In general terms, we'd go look at some ongoing activity to determine the goal of the activity in precise and quantifiable terms. This was known as criterion selection, and it was often the hardest part of the task. Asking the right question generally is. Then we'd study just what people did-not what they said they did, or what the organization charts said they should do, but what they did when they went to work. We'd then make up a mathematical model of the activities and play with that model to see if we could improve production or cut costs by having people do things differently. We'd test the new techniques and go back and work on the models some more.

For example, the original OR teams looked at aircraft search-and-attack patterns to determine which ones got the most cargo through; as you probably suspect from what I said before, this didn't turn out to be the same as the tactics that sank the most subs. Another OR discovery was queuing theory, which resulted in the development of "just-in-time" inventorycontrol methods. Other techniques included linear programming methods for finding solutions to allocation and assignment problems. We also did multiple regression analysis to derive methods for predicting such complexities as college GPA from data on students who are entering college.

It didn't work every time. However, application of OR techniques got some surprising and spectacular results, and there was a period when operations analysts by then called by the more impressive term systems analysts—were the heroes of industry, and no consultant firm could do without a good OR team.

In my day there was one major problem: while you might be able to devise a quantifiable criterion and build an accurate model of the activity, there was no guarantee that you could solve the model. For example, we could use matrixalgebra techniques to relate data on entering students to their eventual GPA, but solving that to yield useful equations required inverting a 75 by 75 matrix; and that task would take lifetimes if done by teams of graduate students punching Monroe calculators.

Enter the computer. When IBM gave the University of Washington a RAMAC 650 computer, the first task of the Grade Prediction Project was to teach it to invert matrices. The 650 had one 10-byte word of main memory and 5000 10-byte words of drum-storage memory. Everything had to



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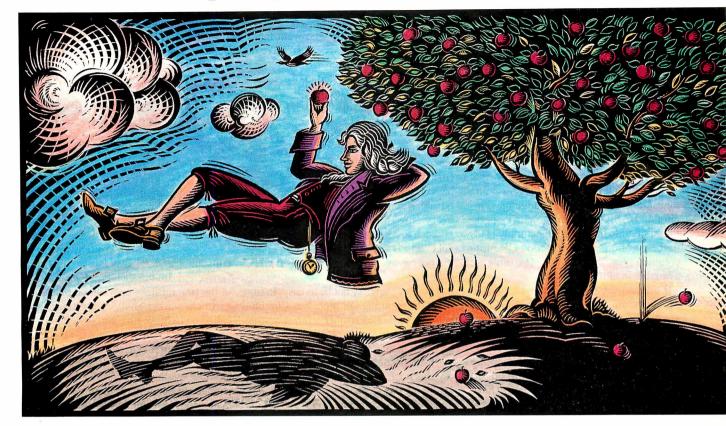


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Pournelle

be fed into it on punched cards, and there weren't any programming languages, so writing a matrix-inversion program was difficult and tedious. I left graduate school before that project was completed, but eventually it was done, and the project worked very well indeed, a spectacular testimony to the usefulness of matrix techniques.

Old OR people would have sold their souls for techniques that modern PCs give anyone access to. Not only is it simple enough to write routines for doing matrix algebra, but many languages, including BASIC, have most matrix operations built into them; which naturally leads to the question, why isn't good OR more common now? It should be. The tools are available to almost anyone.

I suspect the reason has something to do with changing the name from OR to systems analysis, which sounds a great deal more complicated. OR was always done by interdisciplinary teams, and thus we had powerful incentives to keep the language simple so that we could talk to each other. Systems analysis seems to have developed a complex jargon that's incomprehensible without a lot of specialized study.

I suppose that people who want fancy job titles like "systems specialist" have no

choice but to learn the new jargon. Those more interested in getting the flavor of modern OR should get hold of Ian Bradley and Ronald L. Meek's Matrices and Society (Princeton University Press, 1987) and read that carefully. The information density is pretty heavy, but the book has almost no jargon and goes lightly over everything from multiple regression to Markov chains. It's not precisely light reading, but it's not beyond anyone who reads BYTE,

The next step may not be as easy. In my day, the beginning OR bible was Churchman, Ackoff, and Arnoff's Introduction to Operations Research (Wiley, 1957); doubtless there's something better out now, but I don't know what it is. The point is that this book is easier reading now than it was in my day, because many of the equations in the book can be set up and run in something like Mathcad or Macsyma (see last month's column), or for that matter programmed in BASIC. It used to take years to learn how to do things like that.

Now you just have the computer do it.

OR teams often made forecasts that involved some pretty heavy-duty mathematics: as, for instance, the fire-control problem, aiming a gun to put a shell where the target will be when the shell arrives. Targets can be in any direction, moving along any azimuth, and need not be traveling in a straight line or at

constant speed. This is known as a time series, and solving such problems was one of the first military uses of computers.

Stock-market analysts are frequently called on to make forecasts, often from no more real data than the stock's past performance; but that performance data may stretch back a long way in time, far enough to show cyclical behavior. Weather and climate also show cyclical activity, and climate is one determiner of crop—and thus

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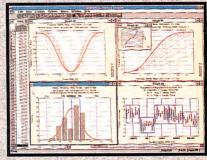
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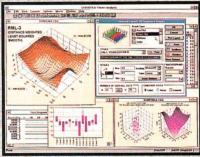
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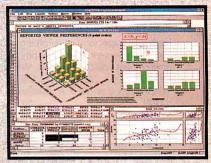


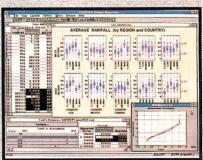
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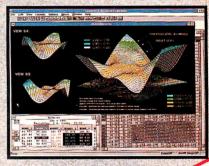
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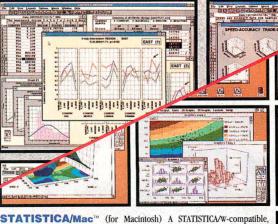


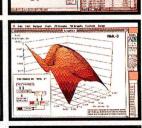












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commodity—prices. You might also want to predict export demand, consumption of some manufactured item such as O-rings or safety pins, credit demand, or whatever.

One method of forecasting is to look at things, think about the problem, and produce a forecast like Athena springing from the brow of Zeus. There are people for whom this works; however, this is a technique useful only to acknowledged experts with a track record. Anyone else will have to show how they got their answer.

The other method of forecasting is to

assemble the past history of everything you think relevant and look for patterns. You use those patterns to predict future behavior. With a great deal of luck, you'll recognize causative factors and be able to build a real predictive model. Usually, though, you won't know why certain patterns repeat, or why some things seem to predict others. You may have a good idea, but you can't really say you understand what's going on; it just happens that way. In those cases, you may also have some nagging doubts about whether you noticed

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There's a tutorial to show you how to use Forecast Pro and a statistical reference section that explains what's going on. The tutorial uses supplied sample data sets that are pretty good for showing you what the program can and can't do and what kind of accuracy to expect from the results. It starts with the assumption that you don't know anything about what you're doing and walks you through. It won't make you a systems analyst or an expert on forecasting, but when you finish the tutorial, you'll know more about forecasting—including its limits—than most of your colleagues.

There are lies, damned lies, and statistics, as the old saying goes, but you can make the case that everything we know, including physical law, is probabilistic (i.e., based on statistical inference). I won't try to prove that, but clearly a lot of what we know does depend on probabilities, and those armed with a good understanding of probability and statistics are much better equipped to deal with the real world than those who are not.

For instance, suppose you have two mail-order ads. One is quite expensive to produce and mail, but it seems to be more effective than the other. You are also offered two mailing lists, one small but known to contain people very interested in your product, the other much larger and said to be "pretty good."

You want an optimum strategy. Clearly you need to do some tests, mailing each presentation to a sample of each list. Fine. How many of what do you mail to whom? What confidence will you have in the result?

Rather than make wild guesses, most people at this point will hire an expert, only how do you know the expert is any good? What you really need is some understanding of what statistics is all about.

A great deal of classical OR dealt with probabilities and statistics, and doing statistical analysis without computers was right up there with root-canal therapy for enjoyment. Because the mechanical work

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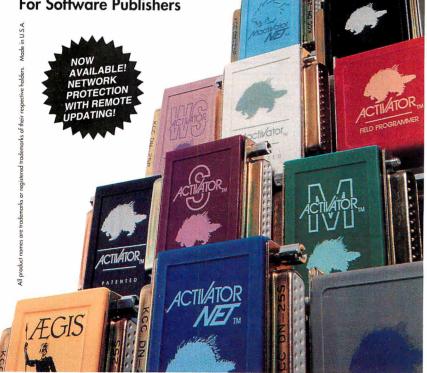
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those that support a host running Windows. So they allow just one connection at a time, and demand total attention from your computer. But Proxy is a Windows application that lets you make multiple connections simultaneously.

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in statistics was boring and tedious, the whole subject got a lousy reputation; but it doesn't have to be that way. Now true, the American school system seems dedicated to the notion that self-esteem is more important than accomplishments, so studying math is discouraged lest the student find it too difficult and get a bruised ego; but the actual elements of probability and statistics aren't hard to understand. Manipulating the numbers can be tedious, but you don't have to do that. Use Systat.

I once pointed this out to a friend in the police department, and for some reason he believed me. He got Systat running on his home computer and began to analyze the crime data that floated around his precinct headquarters. The results were important enough to earn him two promotions in five years, and now he's teaching the subject to other detectives.

I can't promise that good a result to everyone, but I can say that I sure wish I'd had Systat in my early OR days. What with a matrix-manipulation language, a forecasting program, and Systat, I'd have been the greatest OR man alive; and indeed, if I ever get tired of what I'm doing, I know what I'll do.

Polysoft's PS-Plot 1.2 is no Sy-

stat, but it's a lot cheaper. Check it out if you already know about statistics and all you want is something that will accept

your data, plot it, and crank out analyses. For many it will do the job, such as if you need to prepare a paper using correlations, T-tests, F-tests, and the other usual stuff.

The manual is best described as terse. There's a set of lessons, and the package as a whole is superior to the introductory statistics course I took at the University of Iowa. You can learn how to do statistical cookbook operations

with this. You aren't going to learn why you do those things, but we didn't learn that in Introduction to Statistics; few do, especially in education and the social sciences.

Overall, PS-Plot is a satisfactory package with some spectacular graphical capabilities. It's more than satisfactory for people who pretty much know what they want to do and don't need all the capabilities of Systat.

Before the solar eclipse of 1991.

we drove down Baja California to a beach in Todos Santos to watch it on July 11. It's hard to believe that was almost two

years ago. Anyway, watching the eclipse was certainly spectacular enough to make that rather grueling and very hot trip worthwhile. You can read all about it-including how we used the Magellan GPS NAV 1000 Pro system to access the global positioning satellites to tell us exactly where we were-in my November 1991 column.

However, if you have a Mac II and want to experience

the eclipse, get Warner New Media's View from Earth CD-ROM. It's not like being there-nothing could be, not without shadow bands—but it's certainly an experience. With audio narration, tons of text. diagrams, simulations, and color photographs and illustrations, this will tell you as much about eclipses as you're likely to want to know. If you're into eclipses, or want to be, get View from Earth. Recommended.

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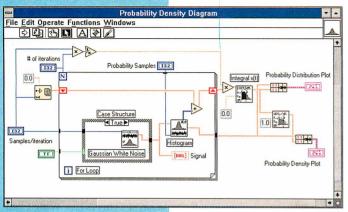
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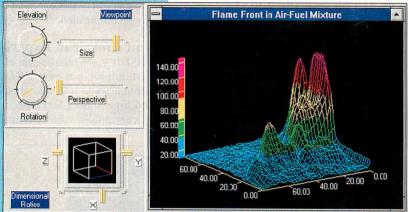
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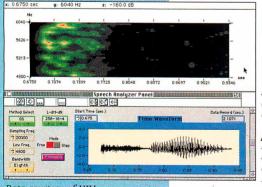
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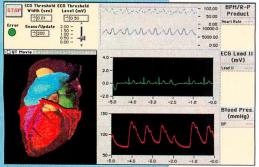
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If you don't know about Battle Chess, you should: it's pure fun. In theory, you can play Interplay's Battle Chess against your computer, or two humans can play against each other. In practice, you'll find yourself letting the computer play itself just so you can watch. The pawns attack or cringe away. Rooks turn into monsters; a rook taking a queen is a thing to see. The bishops use magic. Queens slink across the board. King takes queen is fascinating. There are sound effects, too. We

have Battle Chess running on a CD-ROM with Sound Blaster Pro, and everyone loves to watch it.

They have a "futuristic" version of Battle Chess as well. Some like that better than the "classical" version. Both are extremely well done, with graphics and sound working together to produce real humor. (Now, for a matchup of the futuristic team against the classical one....)

Interplay also puts out a typing tutor, Mario Teaches Typing. Roberta reports: "The graphics are Interplay's usual high quality. Mario is nothing if not colorful! Strictly speaking, this may not teach typing; it's really a game. If you can already type, it will drive you bananas to try to type just one letter at a time. Of course, Mario has to teach you about the home row, and his pudgy fingers are color-coded so that you will use the correct one to press the indicated key."

After you reach 10 words per minute, you can graduate to Water World. Roberta says it has a "Niven/Pournelle feeling of

entering a castle or museum that has been magically waiting for you," and she really likes the images. All told, Mario teaches typing about as well as most programs do, and this one's pretty.

If you like the zoo, get The Animals, a multimedia CD-ROM about the San Diego Zoo, designed by Arnowitz, Inc., and published by The Software Toolworks. It's got

what you'd expect and a lot more. There's a map and interesting ways to get around. There's a children's level and an adult lev-

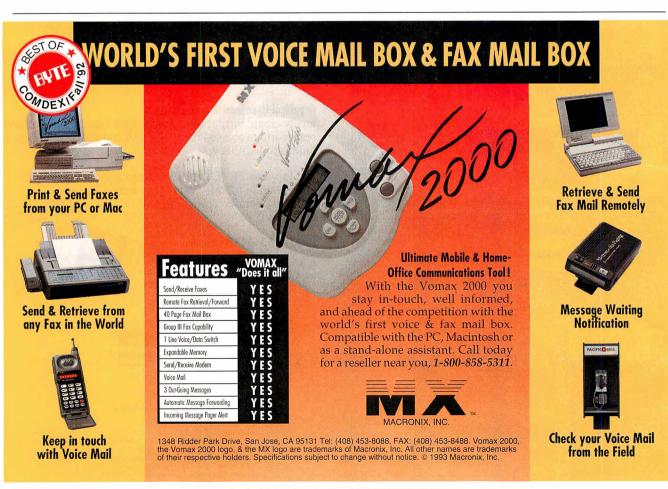
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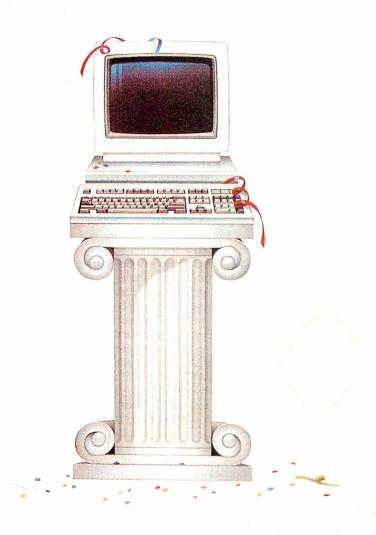
Roberta's reaction: "This thing is fun. The zoo staff tell stories and don't just present a page of facts. They tell you about the workers and veterinarians in the zoo. It makes you interested in their jobs and leads kids to want to know more about those science careers. And that's hot stuff. Catch those girls when they're five or six."

There's also full video with sound. The Windows version runs in a tiny window within the small window the whole program uses, which makes it small indeed, but it's visible. There's a short clip about a condor puppet mother (a hand puppet used to feed a baby California condor), clips about lions, elephants socializing—that sort of thing.

Roberta says, "This is like Wing Commander, only they're learning something real." I have to agree. Try this one; you'll love it. Highly recommended.

The African American Experience: A History is a middle-school-level history textbook put onto a CD-ROM. (I suppose in some areas this would be considered high-school level, but it would have been middle school when I







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was a lad in rural Tennessee.)

It's a very good book. It's straight history, emphasizing the achievements of Af-

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now, and I'm pretty

happy with it. I like

being able to keep

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ricans while embedding them into the history of America and Western civilization. It begins in the Bronze Age, and the authors understand the difference between Egyptian and sub-Saharan African peoples, telling of the interactions and accomplishments of both. It presents the Nubians and Kushites in a fair manner. Moving to American colonial times, it tells of an African-American soldier aboard the boat that carried Washington across the Delaware (and gives a black-andwhite rendering of that famous picture; I saw the original when we did our White House briefing on the SSX program). In other words, this is good Amer-

ican history with emphasis on African-Americans.

The CD-ROM reader is a good one. It runs under DOS and gives an excellent VGA screen image in crisp letters of a

good font. The navigation tools work quite well. There's a decent search engine. Some words are highlighted, but there's no hy-

> pertext capability; however, there is a reference icon that will pop up quotes from people like Ralph Ellison, and there are some cross-references that work.

> It's a good textbook with good reading tools. Alas, it is not a good example of a multimedia CD-ROM. As I mentioned, there's no hypertext. There's very little sound, and what there is isn't very helpful. For example, there's a picture of slaves working in a cotton field. There's a sound button; press that, and a voice tells you that this is a picture of slaves working in a cotton field. That's pointless: there's no need to read you the caption of a photo. Why should the voice messages act

as if you can't read?

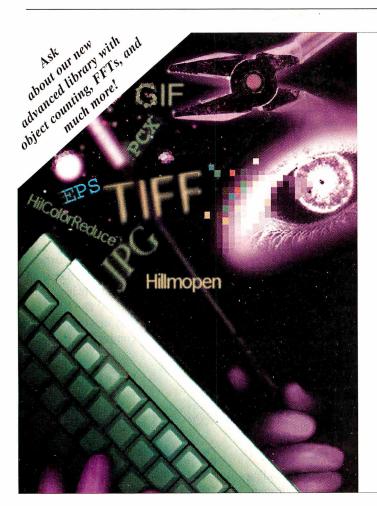
And worse, there's no source data: is this a photo or a drawing? If a photo, when was it taken, by whom and where? And, alas, that's not uncommon. There are a lot of unattributed illustrations.

What this needs is more multimedia. Go to Cal Arts, where they have a wonderful collection of African-American music, and get some clips of that. Add more color illustrations. There is an "art gallery," and some of it is pretty good, but there needs to be more, and it could be presented better. Add maps, and make it easy to get to the appropriate one.

Having said all this, let me emphasize again that this is a good textbook, with good and well-organized content. Moreover, it's easily as well done a CD-ROM as many I have recommended in the past. It's only by comparison with the new generation of CD-ROMs—such as The Animals—that this one is disappointing. Given some of the awful junk that's put out as history nowadays, this is wonderful.

Good content, well-written text, with plenty of illustrations. Recommended.

I've been running Windows for Workgroups for a couple of months now, and I'm pretty happy with it. I like being able to keep resources, like Corel's clip-art files, on the network, available when needed but out of the way. I like



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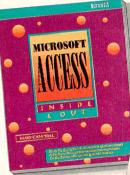
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Pournelle

having my Pioneer CD-ROM drive available in addition to the local Sound Blaster Pro multimedia CD-ROM drive. I like being able to send stuff off to the Pioneer read/write optical drive and knowing I can get it back when I want it; all this and, thanks to Quarterdeck's QEMM-386 6.0 memory management system, I still have DOS windows of 620 KB. I like having Niven's machine linked into mine, so I can move our current work files back

Windows for

perfect network,

it's sure neat.

Workgroups isn't the

but for my operation

and forth and at the same time send a copy off to a glass disk for archiving just in case.

Windows for Workgroups isn't the perfect network, but for a small operation like mine, it's sure neat. It was easy to set up, it's easy to add to, and it takes no work to maintain it.

If you use Windows and you've got a couple of computers, think seriously of networking them. You'll be surprised at the increase in productivity—and Windows for Workgroups is about as painless a way to set up a network as I know.

Some weirdnesses remain, not fatal, but annoying.

One is the very odd behavior of my Sound Blaster Pro. When I launch a program that uses it, I get an error message: "Unable to play sound—the Sound Blaster is in use by another application." It then iconizes whatever I launched and tucks that icon down at the bottom of the screen with the other background icons. If I double-click on that icon, the application launches. It may or may not have sound; usually it does. This happens only on my Cheetah 486/33.

Incidentally, when I talk about the Cheetah 486/33 and Cheetah 486/25, I really should say 486/66 and 486/50. We put Intel's OverDrive chips in both those machines. They work fine, caused no problems whatever, and speeded things up something wonderful. I wish Intel's prices on those chips would come down, but I sure have saved time.

There's an oddness to the video quality, but I understand that one. I've got ATI Technologies' Graphics Ultra Pro boards with the latest 8514/A drivers (downloaded from BIX; the ATI BBS is almost always busy) in the two Cheetah systems. Both machines show CGA graphics; but CGA text is mush on the 486/33, while it's fine on the 486/25.

There's a simple explanation. We use QEMM—I still think it's the best memory manager available—and in the 486/25 we exclude A000–A7FF, while we don't do that with the 486/33. CGA text uses that area. I can't afford to exclude A000–A7FF in my main machine.

I suppose that requires explanation. I use the network to access the Pioneer CD-ROM drive, and for that matter any CD-ROM drive on any machine on the net-

work, but I still need a local drive for quick CD-ROM changes. Until Microsoft builds CD-ROM access tools into either DOS or Windows for Workgroups, I have to run MSCDEX on my local machine. That takes a 15-KB chunk of high memory; and if I exclude A000—

A7FF, I won't have big enough DOS windows. Since some of my programs (and almost all my games) require big DOS windows, I have to live with the result.

One of these days, I'm going to bite the bullet: I'll back everything up on the Palindrome DAT (digital audiotape) drive (which continues to work *wonderfully* well; I *love* the Palindrome system, hardware and software), erase Windows entirely, and reinstall from scratch. Since this will take hours, and my problems are nothing I can't live with, I'm in no tearing hurry to do it. But I suspect that's what it's going to take. Oh, well.

If you need a loan-amortization program and you use Windows, Winmortization Pro 2.1 is a good choice. Put in your loan data, whether this is a U.S. or Canadian loan or mortgage (the defaults are different for the different cases), and you get your answers. There's a little spreadsheet and a file-saving capability. You can build up a spreadsheet to let you compare different options of payment periods, payments, compounding periods, and suchlike.

All told, it's a neat little program that makes good use of Windows. It's simple to use and easy to install. If you don't have a loan-amortization calculator, I can recommend this one.

Alas, when I installed it, I got an odd error message: "! Invalid object use." I've never seen that particular message before, and so far I haven't found anyone who can explain it. The really weird part is that



Pournelle

everything worked fine on the Gateway 2000 4DX2-66V and the Cheetah 486/25; it was only the Cheetah 486/33 that gave me that message.

It doesn't matter. When I installed the current version (2.1) of Winmortization Pro, the problem went away; now the program runs on every machine in the house.

Windows is a big and complex program, and I'm not sure anyone really understands it. Why else would I get weirdnesses that no one can explain?

One of the Windows mysteries is "re-

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Windows mysteries

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One way to

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sources," which isn't exactly the same thing as memory. You can seemingly have plenty of memory and still run out of resources. Worse, resources use a different kind of math from what you're used to. I am told that my system, which tends to operate with about 63 percent resources free, is running on the low side, and when you get down to 25 percent resources free, it's time to panic.

One way to free up resources is to remove needless fonts. If you ever installed CorelDraw on your system, I guarantee you will have some. Many other programs add fonts as well, and every font eats some resources (as well as adding to the time it takes for Windows to load up and initialize). Worse, there is an absolute limit to the number you should load, and Windows doesn't keep you informed.

I recently received a review copy of Windows Programmer's

Guide to Resources by Alex Leavens (Sams, 1992), and I thought I'd try to learn more. Alas, while the book is thorough and complete, it's for programmers and makes few concessions to the rest of us. Windows programmers need this book. The rest of us will have to wait for something simpler to appear.

Want to see Princess Leia turn into Chewbacca the Wookie? ASDG's Morph Plus for the Amiga will do it, and it's something to see. There's also Gryphon's Morph, a similar program for the Mac; you can use it to create QuickTime movies, add animations, or just plain have fun.

Kay Yarborough Nelson's *The Little System Seven Book* (Peachpit Press, 1992) is the book to give an end user who's familiar with System 6 and wanting to use System 7. The real computer book of the

month is by Rich Heimlich, et al., and titled *Sound Blaster*, *The Official Book* (Osborne/McGraw-Hill, 1993). This will give users and programmers alike what they need to know about the most popular sound board, and it's selling like hotcakes.

The book of the month is Charles Pellegrino's *Unearthing Atlantis: An Archaeological Odyssey* (Random House, 1991), with an introduction by Arthur C. Clarke. This is the story of Spiridon Marinatos's excavations on Thera. I spent a fascinating few days with Dr. Marinatos on Thera in

the 1970s, and I've always intended to write a book much like this one; maybe now I won't have to. If you get through that and need some light reading, try Terry Pratchett's *Witches Abroad* (Signet, 1993), one of his Discworld madnesses.

The game of the month is Empire Deluxe from New World Computing. This is an upgraded edition of the classic game Empire. It has much better graphics—switch between 640 by 480 pixels and 800 by 600 pixels on the fly! Nifty. It has several new units and a scenario editor. If you liked Empire, you'll love this. Lord knows the original ate enough of my time. I'm also playing Accolade's Star Control II, a galactic role-playing game with quite an elaborately worked-out story line. I guarantee you will not finish this one in a few hours.

Meanwhile, there's a lot going on at Chaos Manor. I have Mobidem, a Radiomail system that lets me receive and answer my E-mail on a notebook-size system that includes an HP 95LX. People who travel a lot will find this extremely useful: it even works when you're sitting on the taxiway at the airport.

We've got a new Forminco computer desk and chair. The chair looks odd, but it's sure comfortable; a full report after I've had a chance to use them. We've also got a new IBM PS/2 with OS/2 and a CD-ROM drive. I'm sure you'll hear a lot more about that one.

There's a One Stop Music Shop sound board for the Amiga from Blue Ribbon Soundworks that has 32 true stereo voices and software to let you create music.

Next month, all the above, a lot more on networking—I intend to install Novell's NetWare—and Video Spigot from



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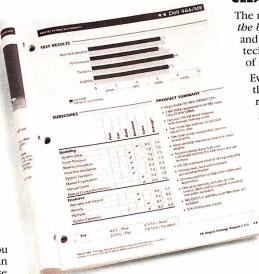
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Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. Jerry welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on BIX as "jerryp."

For More Information

The African American Experience: A History is a very good electronic textbook on CD-ROM that tells African-American history, but it lacks multimedia embellishments. The \$1.29 disc, for DOS systems only, is available from Computerized Educational Resources, Ltd., 1313 Fifth St. SE, Suite 227, Minneapolis, MN 55414, (612) 379-3928. Circle 1146 on Inquiry Card.

The Animals CD-ROM takes you on a tour through the world-famous San Diego Zoo. You'll love it. DOS, Windows, and Mac versions sell for \$119.95 from The Software Toolworks, 60 Leveroni Court, Novato, CA 94949, [800] 234-3088 or (415) 883-3000. Circle 1147.

Battle Chess is a \$79.95 Windows chess program on CD-ROM with spectacular animations. It's available from Interplay Productions, 17922 Fitch Ave., Irvine, CA 92714, [800] 969-4263 or (714) 553-6678. Circle 1148.

Empire Deluxe is an upgraded edition of the classic Empire game for DOS systems. Much better graphics. \$59.95 from New World Computing, 20301 Ventura Blvd., Suite 200, Woodland Hills, CA 91364, (818) 999-0606. Circle 1149.

Forecast Pro (for DOS or Windows) is a business forecasting package for nontechnical users. It uses AI technology and built-in statistical-analysis software to analyze data. It sells for \$595 from Business Forecast Systems, Inc., 68 Leonard St., Belmont, MA 02178, (617) 484-5050. Circle 1150.

The Graphics Ultra Pro is one fast video accelerator board, and the 8514/A driver software gives you a roomy display space. Prices start at \$599 from ATI Technologies, Inc., 3761 Victoria Park Ave., Scarborough, Ontario, Canada M1W 3S2, (416) 756-0718. Circle 1151.

Mario Teaches Typing is a \$39.95 interactive touchtyping tutor for DOS systems. It's available from Interplay Productions, 17922 Fitch Ave., Irvine, CA 92714, (800) 969-4263 or (714) 553-6678. Circle 1152.

A big hit at last year's MacWorld Expo, Morph image manipulations only get better with time. It costs \$149 from Gryphon Software Corp., 3298 Governor Dr., P.O. Box 221075, San Diego, CA 92122, (619) 536-8815. Circle 1153.

Morph Plus is a sophisticated morphing program that's available only for Amiga users. The package costs \$295 from ASDG, 925 Stewart St., Madison, WI 53713, (608) 273-6585. Circle 1154.

The Creative Labs Multimedia Upgrade Kit adds sound and CD-ROM capabilities to your PC with the Sound Blaster Pro audio card, a CD-ROM drive, and software. Kits start at \$649.95 from Creative Labs, Inc., 1901 McCarthy Blvd., Milpitas, CA 95035, (800) 998-5227 or (408) 428-6600. Circle 1155.

If your system has an OverDrive socket, Intel's **OverDrive** processors will double the clock speed of the internal CPU core while maintaining the existing clock speed of the external system. Prices start at \$449 from **Intel Corp.**, 2200 Mission College Blvd., Santa Clara, CA 95054, (800) 538-3373. Circle 1156.

PS-Plot 1.12 is no Systat, but it gets the job done for just \$299 and has spectacular graphics. It's available from Polysoft, P.O. Box 526368, Salt Lake City, UT 84152, (801) 485-0466. Circle 1157.

QEMM-386 6.0 is still the best memory manager available for the PC. It sells for \$99.95 from Quarterdeck Office Systems, Inc., 150 Pico Blvd., Santa Monica, CA 90405, (800) 354-3222 or (310) 392-9851. Circle 1158.

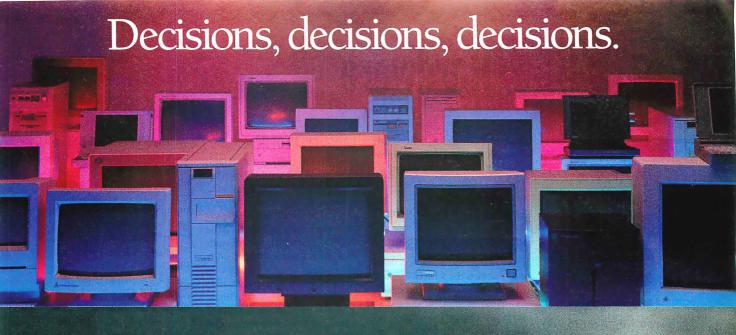
Star Control II is a \$59.95 galactic role-playing game for DOS machines. It's available from Accolade, 5300 Stevens Creek Blvd., Suite 500, San Jose, CA 95129, (800) 245-7744 or (408) 985-1700. Circle 1159.

Systat is a professional statistical-analysis program that's available for DOS, Windows, and the Mac. All versions are \$895 from Systat, Inc., 1800 Sherman Ave., Evanston, IL 60201, (708) 864-5670. Circle 1160.

The View from Earth CD-ROM for the PC and Mac tells you and shows you everything you ever wanted to know about eclipses. It sells for \$79.99 from Warner New Media, 3500 West Olive Ave., Suite 1050, Burbank, CA 91505, (800) 593-6334 or (818) 955-9999. Circle 1161.

Windows for Workgroups provides workgroup applications and file services for creating a peer LAN. It even runs concurrently with NetWare. I'm pretty happy with it. Prices start at \$249.95 from Microsoft Corp., 1 Microsoft Way, Redmond, WA 98052, [800] 426-9400 or (206) 882-8080. Circle 1162.

The Winmortization Pro 2.1 amortization calculator for Windows is a neat little program that lets you quickly compare different payment periods, payments, and compounding periods. It sells for \$99.95 from Etter Industries, Inc., 82 Shoreview Dr., Bedford, Nova Scotia, Canada B4A 1V5, (800) 565-2662 or (902) 835-6060. Circle 1163.



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Harvard Graphics, Microsoft PowerPoint 3.0, CorelDraw Show, and Lotus Freelance Graphics.

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NONNUMERIC COPROCESSOR

From Microway (Strommen, Norway) comes the MS160 Search Engine (\$1665; 238.76 kroner), a PC-based nonnumeric coprocessor board for text processing and fuzzy information retrieval. The MS160 can search through unstructured text and identify words and sentences at a rate equivalent to 64,000 A4 pages per second, Microway says. The 10.5-MB board is expandable to 320-MB of DRAM.

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The cassette-size, 12-ounce Mini EN/SC SCSI adapter (\$459) links PowerBooks to 10Base-T and Thin Ethernet networks. Auto-sensing ports on this device from Asanté (San Jose, CA) allow you to change from one type of network to the other without setting any jumpers or switches. The unit also provides Ethernet docking for closed desktop Macs such as the Classic.

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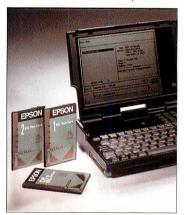
WriterPS (\$999) from Mannesmann Tally (Kent, WA) has 35 fonts as well as Centronics parallel and AppleTalk connectivity. A built-in nickel-cadmium battery supports 150 pages of printing per charge. An integrated fold-out sheet feeder holds 80 pages of letter, legal, or A4 paper.

Phone: (800) 843-1347 or (206) 251-5500.

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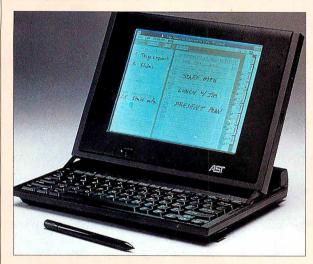
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A docking station for the HP 95LX palmtop, the SmartDock ComStation (\$399.95) provides a built-in fax modem, a serial-parallel converter, DataExchange software for PCs or Macs, and rechargeable batteries. Sparcom (Corvallis, OR) also has available a SmartDock PrintStation (\$169.95).

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HYBRID NOTEBOOK/PEN COMPUTER



The PenExec (\$3000) combines a traditional notebook with a keyboard and a pen computer in a 5.5-pound magnesium box. Based on the Grid Convertible, PenExec comes with DOS 6.0, Windows 3.1, and Windows for Pen Computing installed, as well as demo versions of PenWare's PenCell spreadsheet and Slate's AST Pen Essentials.

PenExec's hinged, backlit monochrome VGA screen hides a high-resolution, 400-dpi digitizer that is activated by the unit's cordless pen. The unit includes a 120- or 200-MB hard drive, a Type II PCMCIA slot, 2 or 4 MB of upgradable RAM, and AST's flash ROM BIOS.

Contact: AST Research, Inc., Irvine, CA, (800) 876-4278 or (714) 727-4141.

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Hardware

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Circle 1283 on Inquiry Card.

LAN PRINT SERVER

The LANpress 1+1 (\$695) from Castelle (Santa Clara, CA) is a self-contained print server for NetWare 10Base-T and 10Base-2 Ethernet networks. Small enough to fit in your hand, the server has a parallel and a serial port and works anywhere on the LAN. You can optimize the speed of the server so that it is compatible with older, slower printers without compromising the performance of newer, higher-speed printers on the LAN. *Phone:* (408) 496-0474.

Circle 1271 on Inquiry Card.

A BUDDY FOR YOUR LASERJET

Autotime's (Portland, OR) LaserBuddy (\$249) is a label- and envelope-printing device that attaches to any Hewlett-Packard LaserJet or compatible printer. The LaserBuddy automatically scans any document sent to the printer and captures an address from within the document. You can then print the address on labels or envelopes with the push of a button.

Phone: (503) 452-8577.

Circle 1272 on Inquiry Card.

A MONITOR FOR PCS AND MACS

The ViewSonic 17 (\$1599), a flat-square, noninterlaced color monitor from ViewSonic (Walnut, CA), features a DQ-DAF (double quadrupole dynamic astigmatism focus) gun. The monitor also has an AIM Shad-

CLEAN-AS-A-WHISTLE INK JET



With a drop-on-demand, 128-nozzle thermal ink-jet print engine, the microMarc printer's (\$419) extended-life ink-jet cartridge (\$40) lasts for up to 1100 pages, TI says. The 300-dpi unit prints 300 cps in letter-quality mode. An automatic sheet feeder handles up to 100 sheets of letter, legal, and A4 paper in portrait and landscape format; a manual feeder handles envelopes. The microMarc includes PCL level 3 emulation, three built-in font families, and DOS and Windows compatibility. The acoustic noise level of the printer is rated at less than 46 dB; the unit weighs 12.1 pounds, is 15.7 by 13 by 5.6 inches, and includes a parallel port.

Contact: Texas Instruments, Inc., Austin, TX, (800) 527-3500 or (817) 771-5856.

Circle 1132 on Inquiry Card.

ow mask, ViewMatch color control that matches printer color output, and a 1600- by 1280-pixel resolution. The drop-down control panel includes color tuning, moiré on/off and tuning, video input voltage, and horizontal and vertical size and positioning.

Phone: (800) 888-8583 or (909) 869-7976.

Circle 1273 on Inquiry Card.

OPEN CLOSED CAPTIONS

The Closed Caption Decoder (\$89) plug-in board and software reveals normally hidden TV closed captions and text. The International Computers (Wauwatosa, WI) package acquires the captions from a TV signal plugged into the FCC-approved

board via the supplied cable and . displays the captions on your computer screen. You can save the captions to a file or print them.

Phone: (414) 764-9000.

Circle 1274 on Inquiry Card.

ADDRESSING SYSTEM HAS NETWORK CONNECTIONS

Designed for stand-alone or network use, the Address Express (from \$795) for PCs and Macs is an on-line addressing system from CoStar (Greenwich, CT). The 12-pound printer with its addressing software prints envelopes, postcards, and cut-sheet labels. The software manages its own mailing lists and prints lists from other programs. The sys-

tem also prints U.S. Postal Service—approved Postnet bar codes for speedier mail delivery.

Phone: (800) 426-7827 or (203) 661-9700.

Circle 1276 on Inquiry Card.

AUDIO/VIDEO COMPRESSION

An audio/video compression board that supports Microsoft Video for Windows, Video Wizard (\$1950) from Advanced Digital Systems (Cerritos, CA) provides 30-frame-per-second real-time audio/video recording. You can display the captured video sequence full-screen or as a scalable, movable picture. An on-screen control pad, which simulates a TV/VCR remote controller, provides the user interface.

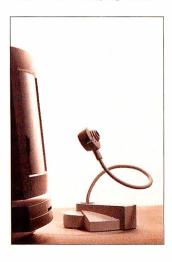
Phone: (800) 888-5244 or (310) 865-1432.

Circle 1277 on Inquiry Card.

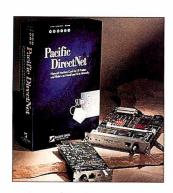
A FLEXIBLE VIDEO CAMERA

FlexCam (\$595), an integrated camera and microphone for desktop video and audio communications, produces color NTSC video and industry-standard, line-level audio output. From VideoLabs (Minneapolis, MN), the ½-inch camera with two directional stereo microphones is compatible with most video-digitizing boards for Macs and with Microsoft Video for Windows.

Phone: (612) 897-1995.
Circle 1141 on Inquiry Card.



What's New Hardware



A TWO-NETWORK PRINTER

Completely transparent to the user, the Pacific DirectNet print server card (\$699) allows Net-Ware and TCP/IP network users to access the same printer simultaneously. The Pacific Data Products (San Diego, CA) card can locate a LaserJet printer anywhere on either network, eliminating the need to attach the printer directly to the server. The card is upgradable via programmable flash memory.

Phone: (619) 552-0880.
Circle 1139 on Inquiry Card.

ADD A DRIVE TO YOUR PS/2

The QED (Quick Easy Disk) Drive System (from \$650) from Sigma Data (New London, NH) is an add-in drive for PS/2 Model 70 computers. The internally mounted drive and controller operate as a second hard drive. The QED disk controller card replaces the existing disk controller card, and the IDE drive mounts in the B drive bay.

Phone: (800) 446-4525.

Circle 1140 on Inquiry Card.

SIMPLIFIED NETWORKING

Available in configurations for 10Base-T or 10Base-2, the soft-ware-configurable TC5143 Ethernet adapter (\$159) from Thomas-Conrad (Austin, TX) is an 8-/16-bit switchless adapter with four ICs and surface-mount technology. Based on National Semiconductor's AT/LANtic chip, the TC5143 is configured for plugand-play ease of use. The company's Ether Tools menu-driv-

en setup and diagnostic utility and Quickset command-line utility are included with the board

Phone: (800) 332-8683 or (512) 836-1935.

Circle 1282 on Inquiry Card.

COLOR PLOTTING

Encad (San Diego, CA) is shipping the Novajet II (\$7995) wide-format plotter. A proprietary dithering algorithm produces a 300-dpi unidirectional color mode that runs four passes per line and minimizes bleeding and buckling by reducing the ink volume per pass. Enhanced black-and-white plotting is also provided.

Phone: (800) 356-2808 or (619) 578-4070.

Circle 1280 on Inquiry Card.

SMART CONNECTION FOR PORTABLES

A portable adapter for connecting notebook computers to token-ring networks, the Smart 16/4 Pocket Ringnode (\$895) runs at either 4 or 16 MBps. The Madge Networks (San Jose, CA) adapter, which connects to your computer's parallel port, is available in two models to support UTP and STP cabling.

Phone: (800) 876-2343 or (408) 955-0700.

Circle 1281 on Inquiry Card.

WORKGROUP PRINTER

The QMS 420 Print System (\$1995) 600-dpi laser printer from QMS (Mobile, AL) is rated at 4 ppm. The printer's parallel, serial, and LocalTalk interfaces

are simultaneously active; each interface has a user-configurable input buffer. The system has a standard 6 MB of RAM, expandable to 10 MB via SIMM modules. QMS ESP technology provides printer-resident emulation-switching capabilities.

Phone: (205) 633-4300.
Circle 1285 on Inquiry Card.

DOLBY SOUND FROM YOUR PC

A playback-only, digital audio card for Dolby AC-2 and other compressed audio formats, the



Antex SX-7 (\$995) from Antex Electronics (Gardena, CA) provides real-time direct-from-disk decoding of files recorded using Dolby AC-2 bit-rate reduction technique. The Windows 3.1–compatible board has playback sample rates up to 50 kHz.

Phone: (310) 532-3092.
Circle 1137 on Inquiry Card.

ACCELERATE IN WINDOWS

Diamond Computer Systems' (Sunnyvale, CA) latest accelerator cards, the ISA bus SpeedStar Pro (\$169) and the VESA localbus SpeedStar Pro VLB (\$179), provide driver support for Windows 3.1, OS/2, AutoCAD, Lotus 1-2-3, Microsoft Word, and WordPerfect. The boards include 1 MB of DRAM video memory and a menu-driven installation program. The SpeedStar Pro VLB comes with Halo Desktop Imager, Panacea's TurboDLD Deluxe, and Diamond's Turbo-Windows.

Phone: (408) 736-2000.

Circle 1279 on Inquiry Card.

IMAGING SYSTEM CUTS PAPER CONSUMPTION

Paperless 1 (\$6995), a complete document-imaging system that connects directly to your PC or Mac, lets you file your paper documents or images electronically. Novell- and AppleShare-compatible, the P1 lets you share your data with others on your network so they, too, can scan, file, view, or send documents. The system includes a gray-scale 400-dpi P1 scanner, a 650-MB P1 optical drive, a 5½-inch P1 optical drive, and P1 software. The four main functions of the software are scanning, retrieval, template design, and administrating. A password-protection window and a paperless print option are also included. Pinnacle Micro claims that the P1 system will reduce paper consumption in the office by 50 percent.

Contact: Pinnacle Micro Imaging, Irvine, CA, (800) 553-7070 or (714) 727-3300.

Circle 1133 on Inquiry Card.



Now, creating a multimedia CD-ROM is as easy as point

and click.



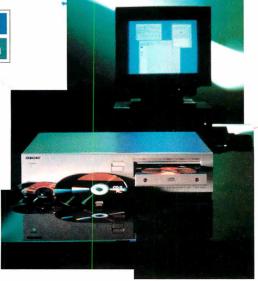


On the PC, simple point and click CD-ROM mastering with Sony's Multimedia ISO Formatter.

Multi-track disc mastering, by simple point and click mouse control on the Macintosh.

Multimedia Formatter available for:





Introducing the Multimedia Formatter from Sony Electronic Publishing.

If you demand a simple, comprehensive solution to creating multimedia CD-ROMs, here's everything you need. The Multimedia Formatter software series from Sony Electronic Publishing combined with the Sony CDW-900E CD-ROM write-once recording unit gives you the premier multimedia CD-ROM mastering system. Available for both PC and Macintosh. Multimedia Formatter software enables you to output a real or virtual ISO 9660 premaster image, CD-XA, CD audio, electronic book (8cm) or CD-I. Plus, it supports the new Sony MMCD. Engineered to support Red Book audio and Mode 1 and Mode 2 files, Multimedia Formatter doesn't require a huge hard disc and accommodates 2X speed recording. Plus you can master multiple discs simultaneously. So if you're in the market for a multimedia CD-ROM solution, choose Multimedia Formatter for PC or Mac. It makes mastering your next CD-ROM as easy as point and click.

The Multimedia Formatter software and the Sony CDW-900E are available through the PDSC division of Sony Electronic Publishing, which specializes in software development products, training and engineering.

For further information:

TEL: (800) 654-8802 FAX: (408) 372-9267

The Multimedia Formatter with the Sony CDW-900E CD-ROM recording unit, delivers a total CD-ROM mastering system.



What's New Hardware



VIDEO PROJECTION

An active-matrix LCD color projection panel, the PanelBook (\$5995) is compatible with domestic and international video formats and power sources. The notebook-size panel from In Focus Systems (Tualatin, OR) projects full-motion video computer graphics.

Phone: (800) 327-7231 or (503) 692-4968.

Circle 1142 on Inquiry Card.

PCMCIA LAN ADAPTER

The EthernetCard (\$299) is a PCMCIA card from Linksys (Irvine, CA) that provides access to a standard Ethernet network. The credit card—size LAN adapter, with 16 KB of RAM, 128 KB of flash RAM, and automatic configuration, supports 10Base-2 or 10Base-T networks.

Phone: (800) 326-7114 or (714) 261-1288.

Circle 1278 on Inquiry Card.

POCKET MODEM WITH FAX

General DataComm's (Middlebury, CT) GDC 914 Pocket (\$725) is a full-featured V.32bis modem with integrated V.17 fax support and speeds as high as 14,400 bps. The unit measures 5 by 2.2 by 1.2 inches.

Phone: (203) 574-1118.

Circle 1286 on Inquiry Card.

TRUE-COLOR SCANNING

The Sagitta Color (US\$299; NT\$7714), a true-color hand scanner from Qtronix (Taipei, Taiwan), gives you access to unlimited dither patterns and independently controlled *x* and *y* axes. The 800-dpi scanner is Windows 3.x—compatible and

includes a TWAIN scanner driver, the ProImage imaging utility, and the Perceive Personal OCR.

Phone: +886 2 716 3178 Circle 1325 on Inquiry Card.

ADD SPECIAL EFFECTS TO VIDEOS

The Screen Machine II video overlay board (\$1203; £795) integrates live video in true color at a 1024- by 768-pixel resolution. The Magnifeye (London, U.K.) board supports Microsoft Video for Windows; its digital filtering while recording Microsoft Video Movies lets you play back the movies on any Windows PC without additional hardware.

Phone: +44 71 221 8024.

Circle 1326 on Inquiry Card.

SBUS SPEEDSTER

A single-width SBus accelerator for Sun SparcStations and compatibles, the RM03 (\$3837.50; £2500) from Riverside Machines (Cambridge, U.K.) is based on

the 860XR RISC processor. Available in speeds of 25, 33, and 40 MHz, the accelerator card has 2 or 8 MB of memory. The card's 64-bit floating-point coprocessor operates in parallel.

Phone: +44 223 321083.

Circle 1327 on Inquiry Card.

COLOR ANIMATION

Commodore Business Machines (West Chester, PA) has added the Amiga 4000-030 (\$2399) to its line of desktop computers. The unit comes with AmigaDOS release 3; 2 MB of chip (i.e., video) RAM; 2 MB of fast, standard 32-bit RAM; and a 120-MB hard drive. The AGA custom coprocessor chip set lets you display and animate graphics in multiple resolutions at up to 256,000 colors.

Phone: (215) 431-9100.

Circle 1328 on Inquiry Card.

EXPANDABLE HUB

A miniature nine-port Ethernet hub that you can link with five

other identical hubs, the Patton Model 2108 (\$425) from Patton Electronics (Gaithersburg, MD) lets you create a single repeater set of eight AUI connections and 48 10Base-T connections. The 1.6- by 5.5- by 7.5-inch hub supports AUI distances to 165 feet and twisted-pair distances to 330 feet. Each 10Base-T port has an LED status indicator.

Phone: (301) 975-1000.
Circle 1329 on Inquiry Card.

PCMCIA DRIVES

The MCDisk-1 (\$675) PCMCIA memory-card drive from Gespac (Mesa, AZ) is designed to interface with any desktop PC or workstation through a SCSI connection. The external drive has a built-in power supply, SCSI address select, and two SCSI connectors.

Phone: (602) 962-5559.

Circle 1330 on Inquiry Card.

Intégral Peripherals' (Boulder, CO) PocketFile PCMCIA drives (from \$495) are PCMCIA Type III–compatible. The drives, available in 42- and 85-MB capacities, have an average seek time of 18 ms and a 32-KB buffer.

Phone: (303) 449-8009.
Circle 1331 on Inquiry Card.

PUT TV ON YOUR COMPUTER

TelevEyes/Pro (\$799.95) from Digital Vision (Dedham, MA) features multiflicker filtering and genlock. The computer-to-TV video scan converter works with PC VGA and Mac output.

Phone: (617) 329-5400.
Circle 1332 on Inquiry Card.

REMOVABLE MAC DRIVE

The hammerDisk105 removable cartridge drive (\$1299) from FWB (San Francisco, CA) has a 105-MB capacity, an average seek time of 14.5 ms, and a rotational speed of 3600 rpm. It ships with Hard Disk ToolKit SCSI utility software.

Phone: (415) 474-8055.
Circle 1333 on Inquiry Card.

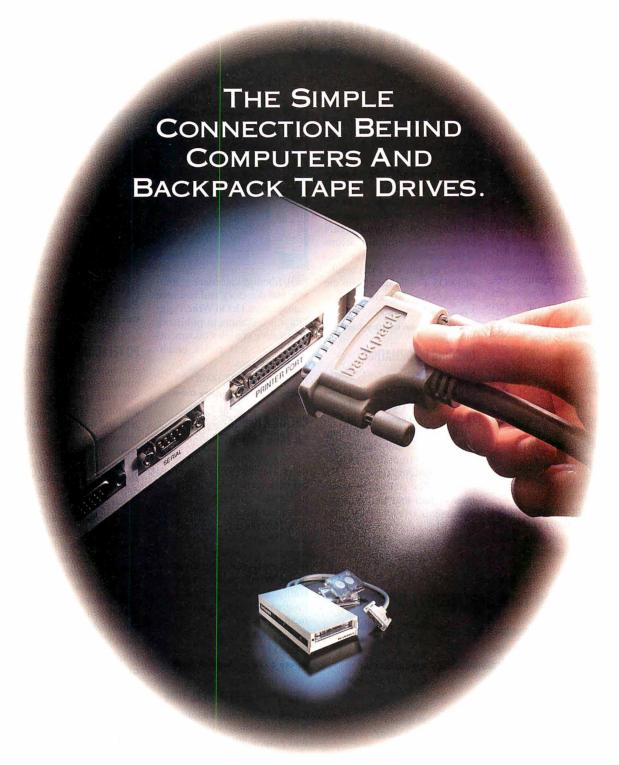
MODULAR FAULT-TOLERANT SUBSYSTEM FOR OS/2

Raidion LT (from \$8960), a modular fault-tolerant disk array for OS/2 and LAN server-based systems, can be configured as a twomodule 500-MB mirrored system or as a 28-GB system, with various configurations in between. Each module has its own 31/2-inch drive, power supply, and cooling fan. The Raidion LT is hot-



swappable in all configurations. Thus, you can replace a failed module at any time without interrupting array or host system operations. You control the system through a GUI directly from your workstation or console as you do any standard OS/2 application.

Contact: Micropolis Corp., Chatsworth, CA, (818) 709-3300. Circle 1134 on Inquiry Card.



It's fast. It's small. It's reliable. It's incredibly compatible.

Backpack is the best selling parallel port tape drive on the market. We'd like to tell you why.

With Backpack, tape backup is quick and simple. Just plug it into your printer port and it's ready to use. No hardware conflicts, no slots required. One model fits all IBM PCs, compatibles and portables, regardless of CPU speed.

Backpack can store up to 250MB on a tape using data compression, is completely QIC80 compatible, and reads QIC40 tapes. With its compact size

and IMbps transfer rate, Backpack is the smallest and fastest parallel port tape drive you can buy.

Micro Solutions is dedicated to the perfection of backup technology.

CD-ROM, hard drive, and diskette Backpack drives are also available. Call today for ordering information and a dealer nearest you.

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MicroSolutions 132 West Lincoln Highway DeKalb, IL 60115

See us at Comdex, Booth #2348
Circle 114 on Inquiry Card (RESELLERS: 115).

What's New Software

TECHNICAL REFERENCES ON DISK

Three Electronic Handbooks from MathSoft (Cambridge, MA) provide interactive, easily accessible technical data when used with Mathcad 3.1. The three titles-Theory and Problems of Electric Circuits from Schaums' Outline Series (\$69, McGraw-Hill), Topics in Mathead: Advanced Math (\$99, MathSoft), and Electrical Engineering (\$99. MathSoft)—give you access to formulas, constants, and diagrams. You can change parameters and plots and watch Mathcad calculate answers in the handbook or save the answers for later reference.

Phone: (800) 628-4223 or (617) 577-1017.

Circle 1305 on Inquiry Card.

MERGE FRAMEMAKER WITH YOUR RELATIONAL DATABASE

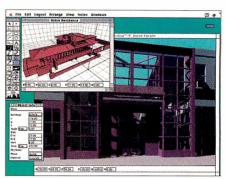
IXOS-FrameMerger (\$2995) links Frame Technologies' FrameMaker desktop publishing software with most relational databases. The software, from IXOS Software (Munich, Germany), is based on the company's IXView/SQL graphical query generator for Unix relational databases. Without any knowledge of programming or SQL, you can create mailmerged documents and make ad hoc queries of Oracle and Informix relational databases. Editing tools let you create customized communications and automate document production. You can view the results of IXOS-FrameMerger on the screen or save them to a file.

Phone: +49 89 460050.

Circle 1292 on Inquiry Card.

ONGOING INFORMATION SHARING

OnGo Office (\$70 per 100 users) and OnGo Write/Paint/Draw (\$298 per 100 users) are the first components of the modular and scalable OnGo information-sharing software from Uniplex Integration Systems (Dallas, TX). OnGo Office is a native X.400 mail system that can transport documents over TCP/IP, OSI networks, and LAN networks such as NetWare and LAN Manager. The module includes E-



mail, filtering, calendaring, routing, and directory and resource management. OnGo Write/Paint/Draw is a document publisher for creating complex documents that include text, tables, graphics, and images.

Phone: (214) 717-0068.

Circle 1294 on Inquiry Card.

CREATE A HABITAT ON YOUR COMPUTER

A desktop manager for Windows, Habitat (\$99.95) is also a network manager for LAN administrators (from \$349). From Computer Knacks (Shrewsbury, NJ), Habitat supports data objects, custom and multiple desktops, group and ad hoc toll launches, and full drag-and-drop under Windows 3.1. You can configure Habitat to replace the Program Manager or to supplement it.

Phone: (800) 551-1433 or (908) 530-0262.

Circle 1296 on Inquiry Card.

VIEW YOUR DATA IN REAL TIME

The Windows-based application Realtime Vision (\$395) collects and graphically displays constantly changing business and manufacturing data in real time. The Laboratory Technologies (Wilmington, MA) product lets you monitor your business activities by connecting the graphical display to business databases. The software also converts data into trend charts, digital readouts, analog meters, and dials to let you watch the data as it changes.

Phone: (508) 657-5400.

Circle 1300 on Inquiry Card.

◀ 3-D MODELING

Design Workshop 1.0 (\$895) from Artifice (Eugene, OR) is 3-D CAD software for the Mac. You can create, move, resize, and reshape models graphically with a 3-D crosshair in a live perspective-modeling space. The software uses a Mac-

Draw-style interface.

Phone: (503) 345-7421.

Circle 1295 on Inquiry Card.

PC TELECONFERENCING

An audio-visual PC teleconferencing package from Modus Software (Los Altos, CA), Synconference (\$395) lets you present and discuss electronic documents on two remotely linked computers. Synconference is compatible with Windows 3.1 and works with a standard modem running at 1200 bps or higher. During a remote presentation, Synconference acts as two synchronized slide projectors; a special feature can exchange the roles of presenter and listener at any time. You can create and rearrange the slide stacks from various bitmap files and save images in bit formats such as BMP, GIF, TIF, and PCX.

Phone: (415) 964-1936.

Circle 1302 on Inquiry Card.

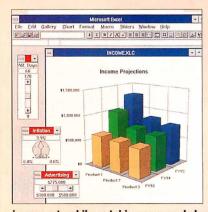
DATA ANALYSIS AND VISUALIZATION

Research Systems' (Boulder, CO) IDL for Windows (\$1500) is a software environment for application development, analysis, and visualization of any type of data. The software incorporates the features and capabilities of Unix-based versions, including a built-in GUI toolkit, 2-D and 3-D plotting, and state-of-the-art volume visualization.

Phone: (303) 786-9900.

Circle 1298 on Inquiry Card.

SLIDE THROUGH YOUR SPREADSHEET UPDATES



Sliders & Dials (\$79.95), a spreadsheet application for Excel for Windows, provides interactive tools for data analysis, forecasting, planning, and what-if analysis. The software lets you graphically manipulate data at predefined

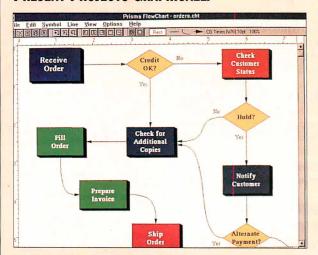
increments while watching your worksheet or chart change to reflect the impact of your manipulation. You can assign as many as 14 virtual dials or sliders to worksheet cells and manipulate each cell's value by moving the position of the pointer.

Contact: Golden Technologies, Inc., Lake Oswego, OR, (800) 653-2201 or (503) 620-2201.

Circle 1287 on Inquiry Card.

Software

PRESENT PROJECTS GRAPHICALLY



FlowChart (\$59), a Windows business graphics program, lets you create and edit presentation-quality diagrams and flowcharts. You can customize charts, use automatic line routing between symbols, and incorporate special effects such as 3-D symbols and overlays. The program imports BMP and WMF files. Horizontal and vertical formats you can choose from include geometric shapes, straight and curved lines, and directional symbols.

Contact: Prisma Software Corp., Cedar Falls, IA, (800) 437-2685 or (319) 266-7141.

Circle 1288 on Inquiry Card.

ADD QC CHARTS TO YOUR SOFTWARE

The QCTalk (\$145) charting program from Omega Engineering (Stamford, CT) adds quality-control charts to existing software, produces X and R charts, calculates quality-control statistics, and captures data directly from other programs. The memory portion of the DOS- and Windows-compatible program reads numbers directly from the screen to other programs.

Phone: (203) 359-1660. Circle 1299 on Inquiry Card.

FONTS FOR WINDOWS, MAC

A library of 303 fully scalable PostScript and TrueType fonts on a CD-ROM, Key Fonts Pro (\$39.95) includes a single CD-ROM for Windows 3.1 and Mac use. Each font package from SoftKey Software Products (Boca Raton, FL) contains 216 classic typefaces and 87 specialty display fonts usable in portrait or landscape mode.

Phone: (407) 367-0005. Circle 1307 on Inquiry Card.

POP-UP DRAWING VIEWER FOR AUTOCAD RELEASE 12

RxEasyView (\$195), from Norway's Rasterex, is available from Expert Graphics (Atlanta,

GA). Viewing features of this utility for AutoCAD Release 12 allow you to search for any drawing on any specification, open a drawing or insert it into an existing drawing, view 16 drawings simultaneously,

and view small, quick-view, or full-screen displays. The utility works with any VGA and highresolution graphics board and supports DOS, Windows, and Sun operating systems. A version that uses AutoCAD Release 12's Proteus interface (\$295) lets you run outside AutoCAD as well as inside.

Phone: (800) 648-7249 or (404) 320-0800.

Circle 1291 on Inquiry Card.

CREATE APPLICATIONS FASTER

Sheridan Software Systems' (Melville, NY) 3-D Widgets (\$109) lets you create applications for Windows that give Visual C++-based applications a state-of-the-art look and feel. With 3-D Widgets, you can apply prebuilt objects to dialogs in the Visual C++ AppStudio toolbox without needing extra coding.

Phone: (516) 753-0985. Circle 1301 on Inquiry Card.

SAFE MAC BACKUP

SafeDeposit (\$99 through July, then \$189) gives you automated backup for your Macintosh files. The application, from Dayna Communications (Salt Lake City, UT), creates a backup plan that determines which files to back up, as well as where, when, and how to back them up. Backup can occur continuously, on command, at system shutdown, when you insert a disk, or at a specified time.

Phone: (801) 269-7394. Circle 1303 on Inquiry Card.



Software Update

The Mathcad 4.0 (\$495) technical calculation program from MathSoft (Cambridge, MA) now offers the



SmartMath intelligent interface. SmartMath's

symbolic/numeric optimization feature uses Mathcad's symbolic processor to simplify expressions before they are computed. Version 4 also supports 32-bit processing using Microsoft's Win32s libraries.

Phone: (800) 628-4223 or (617) 577-1017.

Circle 1315 on Inquiry Card.

Modular Terminal Server 3.0

(8-port terminal server, \$1695) from Specialix (Campbell, CA) adds Reverse Telnet, SNMP, and multiple printer support for up to nine printers.

Phone: (800) 423-5364 or (408) 378-7919.

Circle 1319 on Inquiry Card.

PackRat 5.0 (\$395) from Polaris Software (San Diego, CA) adds customizable folders, forms and lists, and objects; the Instant Options menu; OLE objects; the PackRatBASIC macro language; scripts; and Smart-Start. Improved functions



are action-bar customization, data transfer, E-mail, and integration.

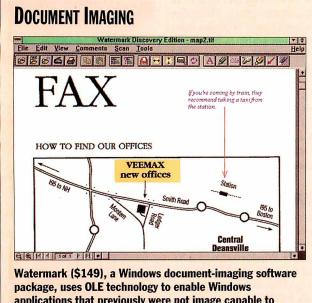
Phone: (800) 722-5728 or (619) 674-6500.

Circle 1320 on Inquiry Card.

Tivoli Systems' (Austin, TX) **Tivoli Management Environment** Release 1.6 now has configuration and change services that simplify and automate setting up, maintaining, and changing enterprise-wide networks of client/server computers.

Phone: (512) 794-9070. Circle 1318 on Inquiry Card.

What's New Software



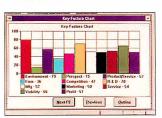
package, uses OLE technology to enable Windows applications that previously were not image capable to manipulate, copy, store, and distribute images of incoming faxed and scanned documents. The software lets you integrate paper or fax-based documents as Image Objects into existing Windows applications such as E-mail and databases.

Contact: Watermark Software, Inc., Burlington, MA, (617) 229-2600.

Circle 1289 on Inquiry Card.

GAIN BUSINESS STRATEGY INSIGHT

Focusing on nonfinancial factors that affect a business strategy, Business Insight for Windows (\$495) provides graphical analyses relating to your business and marketing strategies. In addition to pointing out strengths, weaknesses, and inconsistencies, Business Resource Software's (Austin, TX) Business Insight provides hyperlinked text and graphics, a way to compare alternative strategies, and a tracing facility that lets you follow the program's logic in arriving at conclusions.



Phone: (800) 423-1228 or (512) 251-7541.

Circle 1297 on Inquiry Card.

UNIX DISK MIRRORING

A disk-mirroring product for SCO Unix and Open Desktop, VxMirror (\$595) features full disk-mirroring functionality for standalone, networked, and replicated system configurations. The Veritas Software (Santa Clara, CA) product provides streamlined procedures for setting up mirrored configurations. Informational messages appear during installation, and messages that require reconfirmation appear if you try any action that might damage data.

Phone: (408) 727-1222.

Circle 1306 on Inquiry Card.

STATISTICS AND GRAPHICS IN WINDOWS

Statistica/W (about \$535; £790), is a Windows 3.1-compatible statistical data analysis and scientific graphics system from StatSoft (Old Hatfield, Herts, U.K.). The software maintains data files in spreadsheet format and lets you customize graphics images via drawing and scaling options. File import and export facilities are included.

Phone: +44 462 482822.

Circle 1308 on Inquiry Card.

OPEN THE TRANSOM TO WINDOWS

Transom (\$129), from Metro Software (Tucson AZ), creates a compatible pathway for DOS programs to gain the benefits of Windows-scalable TrueType fonts, print manager, and printer drivers. The DOS applications are automatically integrated into the Transom Launch Pad, from which you can open any DOS application into Windows. All Windows functions are managed in the Launch Pad, which remains in the background until needed.

Phone: (800) 697-6971 or (602) 292-0313.

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EASY WINDOWS PROGRAMMING

The OptiScript developer's toolkit (\$399.95) provides real-time PostScript display on your PC and output of PostScript code to any raster device, such as monitors, printers, and film recorders. From Postcraft International (St. Catharines, Ontario, Canada), OptiScript includes full bit-map manipulation and interfaces between the software application and the Windows graphics GDI, letting you program Windows graphics directly, without having to program the GDI.

Phone: (416) 641-0768.

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Software Update

XRunner Release 2.0 (from \$10,000 per floating license) from Mercury Interactive (Santa Clara, CA) now has an automated software-testing system that creates tests that adapt to changes in GUI-based applications without having to re-create tests each time a GUI element changes location in a new release.

Phone: (408) 987-0100.

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Act for Windows version 1.1

(\$395) from Contact Software International (Carrollton, TX) adds data integration and portability, a point-andshoot import filter for dBase IV and ASCII files, and filters to import data from other contact managers and PIMs.

Phone: (214) 919-9500. Circle 1316 on Inquiry Card.

Biosoft's (Ferguson, MO)

SolvEq 2.4 (\$299; £149) includes improved editing functions, two-tiered success criteria for the solver, circular operation for constraining unknowns with MIN and MAX, scatter plot symbols added to graphics line styles, and increased maximum array size.

Phone: (314) 524-8029. Circle 1317 on Inquiry Card.

Carbon Copy for Windows 2.0 (\$199) from Microcom (Nor-



wood, MA) adds LAN communication, Asynchronous Communication Server

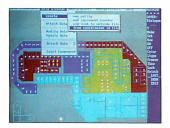
support, high-resolution video support, enhanced DOS support, enhanced data-compression algorithm, drag-and-drop file transfer, remote clipboard, and compatibility with Carbon Copy for DOS. *Phone:* (800) 822-8224 or (617) 551-1000.

Circle 1324 on Inquiry Card.

Software

OBJECT-ORIENTED INFORMATION MANAGEMENT

Object Graphics' (Mountain View, CA) TIMS Toolkit (\$1000; with TIMS R12, \$3500) lets you pro-



gram and customize AutoCAD Release 12. An AutoLisp interface to a library of over 200 routines written in C provides flexibility, reducing the effort required to design and implement GIS and facilities management systems. Features include two-way linkage to outside databases; spatial relationship functions; organizational hierarchical chart buildup; and polygon overlays. You can also attach data to an existing AutoCAD entity or create a new one with attached data.

Phone: (415) 968-1500. Circle 1293 on Inquiry Card.

TALK TO YOUR COMPUTER

Telaccount Speech Recognizer (TSR) (\$69) works in the background until it recognizes words or phrases from its vocabulary. When it recognizes a word, it types a series of keys associated with it as if you had typed them on the keyboard. The voice macro system from Telaccount (Narberth, PA) is compatible with Sound Blaster and features an API that lets Windows or DOS programs directly control the voice recognition system. You can train TSR to understand several people's voices at once. Phone: (215) 664-2410.

Circle 1312 on Inquiry Card.

Voice Blaster (\$119.95) from Covox (Eugene, OR) adds voice recognition to Sound Blaster and compatible sound cards and keystroke-intensive applications. Running under DOS or Windows, the software's voice-command interface can be tied to keyboard and mouse macros. The toolbox lets you record, edit, and play back sound; voice annotation software adds your spoken messages to documents. A high-fidelity headset is included with the program, which runs in the background.

Phone: (503) 342-1271.

Circle 1313 on Inquiry Card.

Voice Command for Windows

(\$179) is a hardware-independent voice-input system from Command Corp. (Duluth, GA) that lets you bring a Windows application to the foreground by saying its name. You can also vocally call commands instead of using the mouse to navigate through hierarchical menus.

Phone: (404) 925-7950.

Circle 1314 on Inquiry Card.

POINT, CLICK, AND ZIP

Zip Manager (from \$19.95), a front-end interface to PKZip and PKUnzip for Windows and OS/2

users, lets you point and click and drag and drop to compress and uncompress PKZip and PKUnzip files. The interface, from Software Builders (Smyrna, GA), uses the Windows MDI feature so that you can open and view more than one Zip file at a time. It can also convert Zip files to Self-Extract Zip files and run PKZipfix.

Phone: (800) 432-0025 or (404) 319-9621.

Circle 1311 on Inquiry Card.

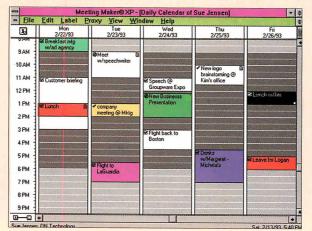
MULTIPLATFORM PRINTING

PowerPrint/NW (\$499) allows Macs to share and print to over 1000 dot-matrix, ink-jet, and laser printers via Novell networks. The GDT Softworks (Burnaby, BC, Canada) software has built-in spooling and the capability to print labels and forms. ability to print labels and forms.

Phone: (800) 663-6222 or (604) 291-9121.

Circle 1310 on Inquiry Card.

GROUP SCHEDULER FOR WINDOWS AND MACS



A Windows and Mac group scheduler, Meeting Maker XP (from \$695) provides seamless interoperability between Windows and Mac clients connected to a single Windows or Mac server. The scheduler lets you plan, schedule, and confirm meetings on either a Windows PC or a Mac. XP's portable client has full support for laptops and PowerBooks as well as the ability to automatically reconcile schedule changes.

Contact: On Technology, Inc., Cambridge, MA, (800) 548-8871 or (617) 876-0900.

Circle 1290 on Inquiry Card.

Software Update

AutoMate/Pro for Windows 2.0 (\$295) from Vermont Microsystems (Winooski, VT)

12 for Windows' display list software with its own



for a one-third memory saving and a three to five times speed increase.

Phone: (802) 655-2860. Circle 1322 on Inquiry Card.

Wildcat 3.6 BBS software (from \$129) from Mustang Software (Bakersfield, CA) has added WcDraw for creating multicolored screens; an upgraded message-reading capability scrolls message text while the message header remains stationary. Now supports Fido Netmail messages. Phone: (805) 395-0223.

Circle 1323 on Inquiry Card.

ICAP/4M PreSpice Module 3.2M (\$275), Intusoft (San Pedro, CA), now offers Monte Carlo statistical yield analysis, parameter sweeping, and circuit optimization.

Phone: (310) 833-0710. Circle 1164 on Inquiry Card.

Mixer View, click-and-drag support, Undo editing options, wider range of time signatures, and Humanize control in Quantize are among the new features of Studio for Windows 3.10 (\$249.95), Midisoft (Bellevue, WA).

Phone: (206) 881-7176. Circle 1165 on Inquiry Card.

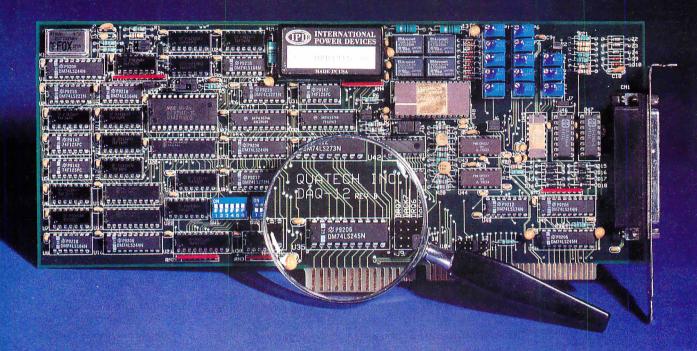
Webcorp (Sausalito, CA) has added Windows and faster performance to WEB Parallel PairWare 4.0 (\$129).

Phone: (415) 331-1449. Circle 1166 on Inquiry Card.

Roomer3 2 (\$395), Hufnagel Software (Clarion, PA), now provides faster 3-D rendering and data handling.

Phone: (814) 226-5600. Circle 1167 on Inquiry Card.

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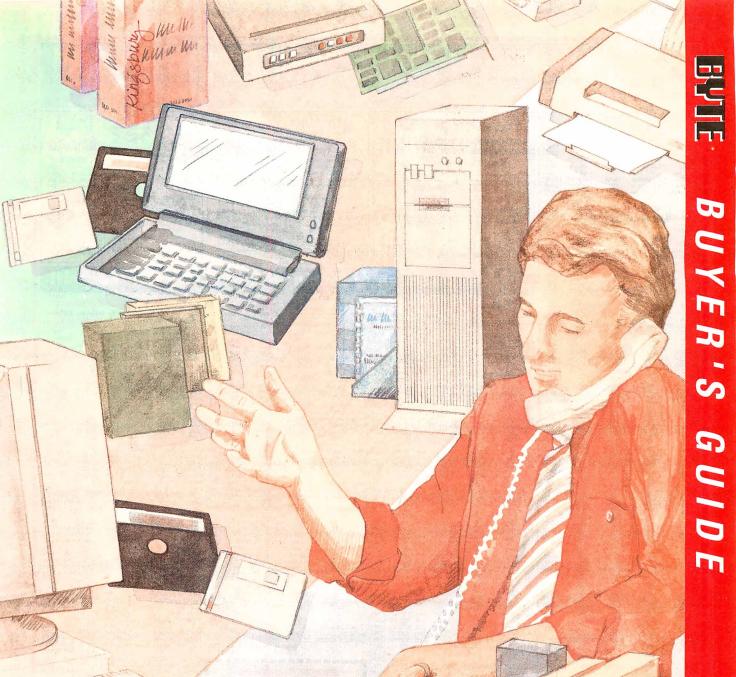


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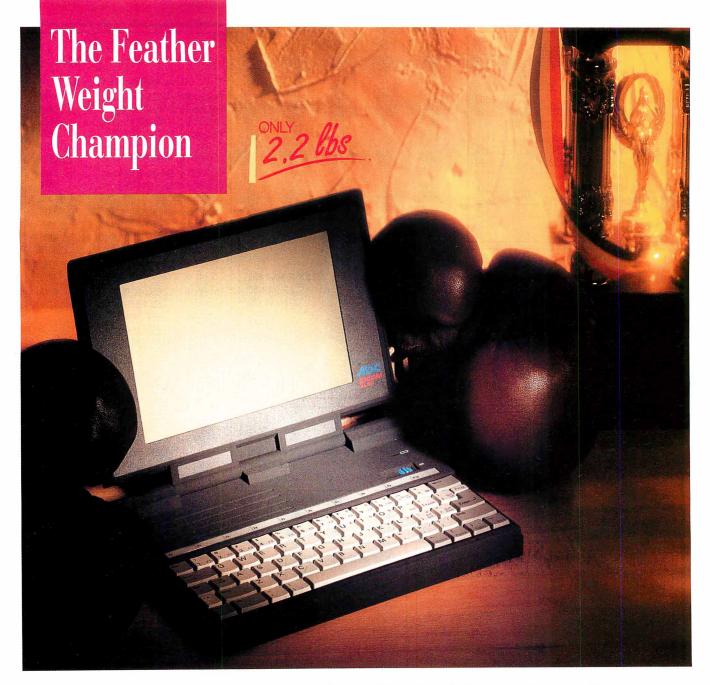
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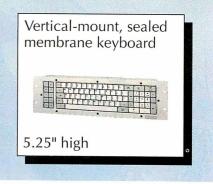




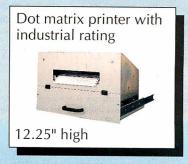
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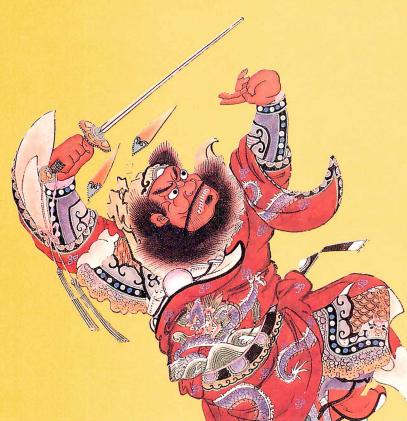
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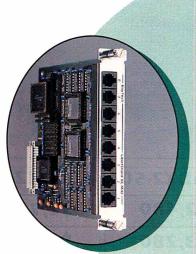
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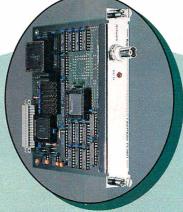
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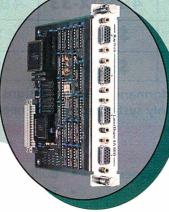
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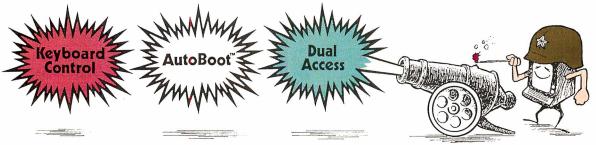
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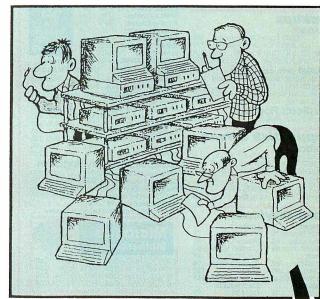
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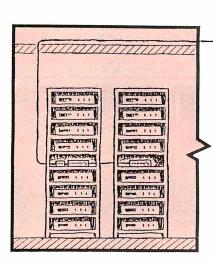
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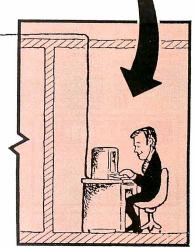


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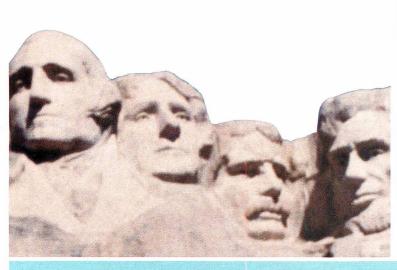
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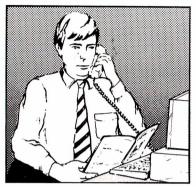
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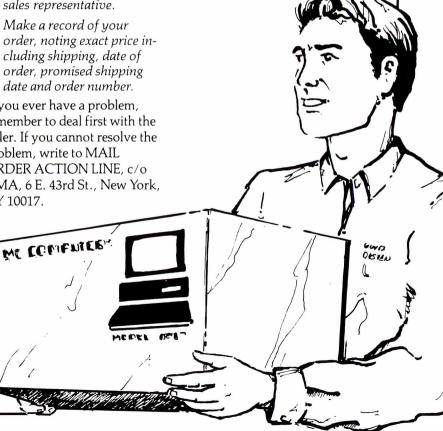
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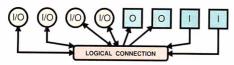
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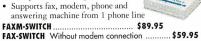
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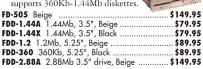
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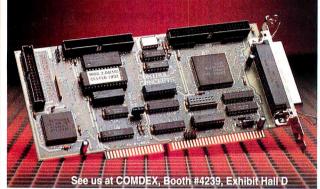
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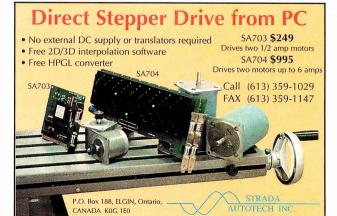
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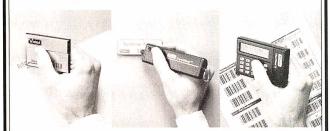


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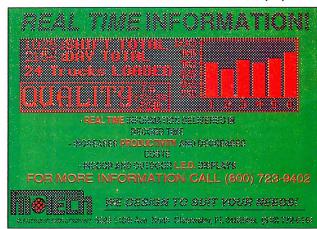
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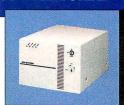
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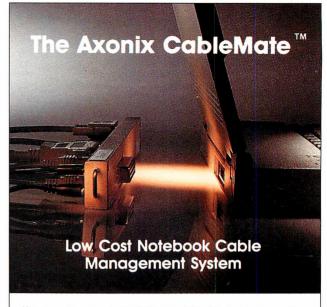
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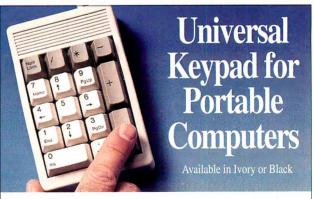
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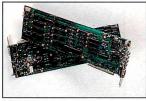
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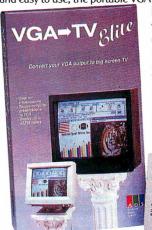
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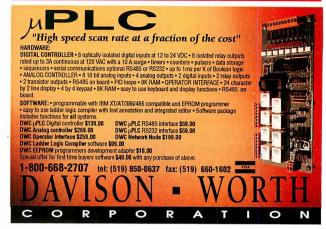
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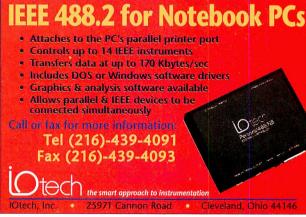


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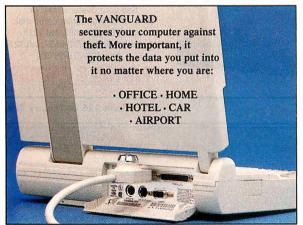
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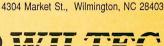
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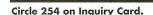


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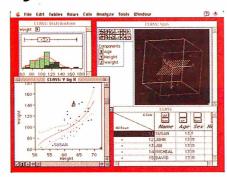
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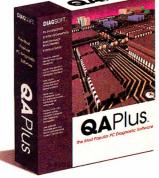
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66-67	BORLAND INTERNATIONAL	11	800-336-6464	250	GENERAL TECHNICS	255	800-487-2538	•	MICROSOFT CORP	123	800-426-9400 ext. JK8
co	DDITICH AIDWAYC	400	ext. 5818	212	GENOVATION, INC	256	800-822-4333		MICROSOFT CORP	125	800-426-9400
68 184	BRITISH AIRWAYS BUFFALO PRODUCTS	120 233	800-345-2356	89-90	GLENCO ENGINEERING	126	800-562-2543				ext. JK8
*	BYTE SUB MESSAGE	215	000-343-2330	76-77	GREENVIEW DATA	135	800-458-3348	•	MICROSOFT CORP	127	800-426-9400 ext. JK8
	-			511	GREY MATTER LTD	128IS-1	+44-0364-53071*	223	MICROSTAR LABORATORIES	254	206-453-2345
	C			256	GSQUARED COMPUTERS	254	214-948-3155	6	MICROWAY	174	508-746-7341
	C USERS JOURNAL 12	28IDRC1-2	913-841-1631	213	GTEK INC	253	800-282-4835		MICROWAY	196	508-746-7341
242	CADSOFT COMPUTER, INC	260	800-858-8355		H			520	MINICOM LTD	112IS-2	+972-2-637576*
259	CALPAC COMPUTER CORP	257	800-800-7222	91	HEWLETT PACKARD	12-13	800-LASERJET	513	MINOLTA	00010 4	10 511 77000
70	CENTRAL POINT SOFTWAR	E 44-45	800-967-9251				ext. 7299	123	GMBH (PAN EUROPE) MINUTEMAN	200IS-1 75	+49-511-77000
501	CHERRY MIKROSCHALTER GMBH (INT'L)	214-215	+49-964-3180	•	HEWLETT PACKARD	26-27	800-SCANJET ext. 7365		MKS / MORTICE KERN SYS	112IS-1	800-238-7272 519-884-2251
528	CHICONY (INT'L)		+886-3-323-5743**	257	HI-TECH ELECTRONICS	253	800-723-9402	0.00	MULTIVENTURE		+886-2-703-1380*
166	CIMMETRY SYSTEMS	152	514-735-3219	214	HI-TECH INSTRUMENTS	256	713-980-9040	0.00000000	MULTIVERSE	200.0	1000 2 700 1000
196	CITITRONICS	246	818-855-5688	273	HONEYWELL KEYBOARD DI		800-445-6939		COMMUNICATIONS USA	128IS-2	212-580-0541
71-72	COLORADO MEMORY SYS	39	800-451-4523						NI.		
74	COMPAQ COMPUTER CORP (N.A.)	20-21	800-638-8258 ext. 45						N		
502-503	COMPEX INC (INT'L)	15	714-630-7302	*	IBM DIRECT (N.A.)	112A-D	407.000.0400	100 to 10	NAGA SYSTEMS CORP	234	800-568-6242
*	COMPUSERVE	144A-B	800-848-8199	94 93	IBM PERSONAL S/W PROD IBM PERSONAL S/W PROD	40-41 115	407-982-6408 800-IBM-30S2	10.000	NANAO USA CORP (N.A.)	15	310-325-5202
75	COMPUSERVE	145	800-848-8199	215	INES GMBH	254	+49-221-491621	118 224	NATIONAL INSTRUMENTS NATIONAL INSTRUMENTS	209 260	800-433-3488 800-433-3488
78	COMPUTER ASSOCIATES	47	899-CALL-CAI	95	INTEGRAND RESEARCH	62	209-651-1203	*	NATIONAL	200	000-433-3400
80	COMPUTER ASSOCIATES	86-87	899-CALL-CAI	97	INTEL CORP	48A-D	800-538-3373			IDRC1-2	512-794-0100
79	COMPUTER ASSOCIATES	99	ext. 176 899-CALL-CAI	96	INTEL CORP	118-119	800-538-3373	119	NEC - SYSTEMS	36-37	800-NEC-INFO
79 504	COMPUTER QUICK	48IS-3	415-861-8330	174-175	INTELLIGENT SECURITY SYS	S 196	800-237-4774	•	NETWORK COMPUTING DEV (N.A.)	111	800-800-9599
185	COMPUTERLANE UNLTD	235	800-526-3482	98-99	INTERGRAPH (N.A.)	128A-F	800-345-4856	190	NEVADA COMPUTER	232	800-654-7762
253	CONTROL CONCEPTS	252	703-876-6444	216	IO TECH	258	216-439-4091	120	NEXT COMPUTER	166	800-TRY-NEXT
207	CONTROL VISION	257	316-231-6647	100 524	IOMEGA ITALIAN S/W AGENCY	155 200IS-3	800-777-4045 +39-323-925208*	121	NSTL	211	215-941-9600
81	COREL SOFTWARE	43	800-836-DRAW		ITERATED SYSTEMS	54	800-4FRACTL				
82-83	COVOX INC	189	800-733-04200	244	IVERSON SOFTWARE, INC	261	416-925-6096		0		
268	CREATIVE LABS INC	29	800-998-LABS		•			122	OKIDATA	79	800-OKI-TEAM
84-85 208	CTX INTERNATIONAL INC	164 252	714-595-6146 612-631-9512		J			523	ON TIME MKT /		ext. 261
	CYBEX CORP	243	205-534-0010**	101	JAMECO ELECTRONICS	93	800-831-4242	523	KARSTEN PETERSEN	128IS-2	+49-40-437472
	CYBEX CORP	24850-2	205-534-0010**	522	JDR MICRODEVICES JEN ELECTRONICA	251 48IS-2	800-538-5000 +39-73-3224035*		OSBORNE MCGRAW-HILL	213	
	CYBEX CORP (INT'L)	CIV	205-534-0010**	217	JENSEN TOOLS	253	602-968-6231	225	OVERLAND DATA INC	259	800-729-8725
				*	JNL OF OBJ ORIENT	1-1-1		515	OXFORD ELECTRONIC PUBL (INT'L)	33	+44-865-56646*
	_				PROGRAMMING 12	8IDRC1-2	212-274-0640		(IIII L)	50	500 00040
	D				K				P		
260	DAEYOUNG ELECTRONICS	255	+82-02-790-6878**	265	KAKIUCHI	255			PACIFIC DATA PRODUCTS	180	619-625-3628
170	DALLAS SEMICONDUCTOR	52	800-258-5061	102	KEA SYSTEMS LTD	202	800-663-8702		PACIFIC GOLD COAST	94	516-759-3011*
210	DATALUX CORP (N.A.)	256	800-DATALUX	218	KILA	254	303-444-7737	262-263	PARALLEL STORAGE SOLU	255	800-998-7839
210	DATALUX CORP (INT'L)	256	800-DATALUX	103-104	KINGSTON TECHNOLOGY	19	714-435-2600	226	PATTON & PATTON	260	800-525-0082
209	DATALUX CORP (N.A.)	257	800-DATALUX	219	KNOWLEDGE BASED SYS	260	409-260-5274		PC DIGEST	216A-B	ext. 112
209	DATALUX CORP (INT'L) DAVISON-WORTH CORP	257 258	800-DATALUX 800-668-2707		L			69	PC DIGEST	210A-B 217	800-232-29283 800-232-29283
534	DEC DEC	112IS-4	000-000-2707	220	LAGUNA DATA SYSTEMS	259	800-938-TAPE		PC POWER & COOLING	89	800-722-6555
*	DELL COMPUTER CORP (N.		800-626-8260	272	LAHEY COMPUTER SYSTEMS		800-548-4778	126	PERSOFT INC	203	800-368-5283
•	DELL COMPUTER CORP (N.		800-626-8260		LANDMARK RES INT'L CORP		800-683-6696	127	PHAR LAP SOFTWARE INC	91	617-661-1510
211	DIAGSOFT INC	261	800-DIAGSOFT	201	LOGICAL CONNECTION	250	800-238-9415	516	PHILIPS MONITORS (INT'L)	76-77	+31-40-73-39-83*
173	DIGISPEECH INC	168	916-621-1787	221-222	LOMAS DATA	252	508-460-0333	17.2000-	PIKA TECHNOLOGIES	253	613-591-1555
	E				M		7		PINNACLE MICRO	8-9	714-727-3300
054 055		n oro	000 000 470	074 075	The second second second	040	000 050 5044	2004	PKWARE INC	194	414-354-8699
251-252 86	EDEN'S TECHNOLOGY COR ELIASHIM MICROCOMPUTE		309-862-1704 +972-4-528613**	274-275	MACRONIX INC MANCHESTER EQUIP CO	210 248A-B	800-858-5311	131 107	POPKIN S/W & SYSTEMS INC	187 55-57	212-571-3434
*	ELONEX (INT'L)		+44-81-452-6422**	537	MANCHESTER EQUIP CO	248A-B 248NE-1	516-435-1199 516-435-1199	*	PROGRAMMER'S PARADISE PROGRAMMER'S SHOP	55-57 200A-D	800-445-7899 800-421-8006
247	ELSIST	258	+39 142 451988**	*	MARK WILLIAMS CO	195	800-627-5967	161-162	PROXIMA CORP	53	619-457-5500

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Fill out this coupon ca	fui	A. What is your primary job function/principal area of responsibility? (Check one)			currently using? (Check all that 12 PC/MS-DOS 15 D Un				
Name	<u>_</u>			☐ MIS/DIP ☐ Programme	er/Systems Analyst		DOS + Windows OS/2	16 ☐ MacOS 17 ☐ VAX/VMS	
					on/Management	E. F	or how many peo	ple do you	
Title			4 [4 Sales/Marketing			influence the purchase of hardware		
				☐ Engineer/S	cientist		oftware?		
Company				☐ Other		18 (1-25	20 🗆 51-99	
					ur level of management	19 (26-50	21 🗖 100 or more	
Address				sponsibility					
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City		State	ZID	☐ Middle-leve	reseller (VAR, VAD,				
				ealer. Cons					
Phone	Fax			Yes	11 □ No	J	une 1993	86 96 99	
Product Category	Disks & Optical Drives	7	Multimedia	19	Educational	30	Shareware	42	
Information	Diskettes/Duplicators	8	Printers/Plotters	20	Engineering/Scientific	31	Software Duplic		
Circle the numbers below for	Fax Boards/Machines	9	Programmable Hardwa	are 21	Entertainment	32	Spreadsheets	44	
information on the entire estagen	Graphics Tablets/Mice/		Scanners/OCR/Digitize	ers 22	Graphics	33	Unix	45	

of products you're interested in

Accessories/Supplies	1
Add-in Boards	2
Bar Coding	,
Communications/Networking	4
Computer Systems	
Data Acquisition	6

Pen Input

Keyboards LAN Hardware Laptops & Notebooks Mail Order Memory/Chips/Upgrades Miscellaneous Hardware

Monitors & Terminals

12 13 14 15 Modems/Multiplexors 17

Tape Drives UPS Software Business CAD/CAM Communications/Networking 27 Data Acquisition Database

25

Mail Order Mathematical/Statistical On-Line Services

Miscellaneous Software Operating Systems Programming Languages/ Tools Security

44 Spreadsheets Unix Utilities 46 35 Windows 47 36 Word Processing 48 37 General Books/Publications Recruitment Miscellaneous 40

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53	79	105	131	157	183	209
54	80	106	132	158	184	210
55	81	107	133	159	185	211
56	82	108	134	160	186	212
57	83	109	135	161	187	213
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59	85	111	137	163	189	215
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61	87	113	139	165	191	217
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71	97	123	149	175	201	227
72	98	124	150	176	202	228
73	99	125	151	177	203	229
74	100	126	152	178	204	230
75	101	127	153	179	205	231
76	102	128	154	180	206	232
77	103	129	155	181	207	233

234	259	284	309	334	359	384
235	260	285	310	335	360	385
236	261	286	311	336	361	386
237	262	287	312	337	362	387
238	263	288	313	338	363	388
239	264	289	314	339	364	389
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244	269	294	319	344	369	394
245	270	295	320	345	370	395
246	271	296	321	346	371	396
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250	275	300	325	350	375	400
251	276	301	326	351	376	401
252	277	302	327	352	377	402
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254	279	304	329	354	379	404
255	280	305	330	355	380	405
256	281	306	331	356	381	406
257	282	307	332	357	382	407
258	283	308	333	358	383	408

409	435	461	487	513	539	565
410	436	462	488	514	540	566
411	437	463	489	515	541	567
412	438	464	490	516	542	568
413	439	465	491	517	543	569
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416	442	468	494	520	546	572
417	443	469	495	521	547	573
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419	445	471	497	523	549	575
420	446	472	498	524	550	576
421	447	473	499	525	551	577
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423	449	475	501	527	553	579
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425	451	477	503	529	555	581
426	452	478	504	530	556	582
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430	456		508	534	560	586
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432	458	484	510	536	562	588
433	459		511	537	563	
434	460	486	512	538	564	590

591	616	641	666	691	716	741
592	617	642	667	692	717	742
593	618	643	668	693	718	743
594	619	644	669	694	719	744
595	620	645	670	695	720	745
596	621	646	671	696	721	746
597	622	647	672	697	722	747
598	623	648	673	698	723	748
599	624	649	674	699	724	749
600	625	650	675	700	725	750
601	626	651	676	701	726	751
602	627	652	677	702	727	752
603	628	653	678	703	728	753
604	629	654	679	704	729	754
605	630	655	680	705	730	755
606	631	656	681	706	731	756
607	632	657	682	707	732	757
608	633	658	683	708	733	758
609	634	659	684	709	734	759
610	635	660	685	710	735	760
611	636	661	686	711	736	761
612	637	662	687	712	737	762
613	638	663	688	713	738	763
614	639	664	689	714	739	764
615	640	665	690	715	740	765

766	792	818	844	870	896	922
767	793	819	845	871	897	923
768	794	820	846	872	898	924
769	795	821	847	873	899	925
770	796	822	848	874	900	926
771	797	823	849	875	901	927
772	798	824	850	876	902	928
773	799	825	851	877	903	929
774	800	826	852	878	904	930
775	801	827	853	879	905	931
776	802	828	854	880	906	932
777	803	829	855	881	907	933
778	804	830	856	882	908	934
779	805	831	857	883	909	935
780	806	832	858	884	910	936
781	807	833	859	885	911	937
782	808	834	860	886	912	938
783	809	835	861	887	913	939
784	810	836	862	888	914	940
785	811	837	863	889	915	941
786	812	838	864	890	916	942
787	813	839	865	891	917	943
788	814	840	866	892	918	944
789	815	841	867	893	919	945
790	816	842	868	894	920	946
791	817	843	869	895	921	947

948	973	998	1023	1048	1073	1098
949	974	999	1024	1049	1074	1099
950	975	1000	1025	1050	1075	1100
951	976	1001	1026	1051	1076	1101
952	977	1002	1027	1052	1077	1102
953	978	1003	1028	1053	1078	1103
954	979	1004	1029	1054	1079	1104
955	980	1005	1030	1055	1080	1105
956	981	1006	1031	1056	1081	1106
957	982	1007	1032	1057	1082	1107
958	983	1008	1033	1058	1083	1108
959	984	1009	1034	1059	1084	1109
960	985	1010	1035	1060	1085	1110
961	986	1011	1036	1061	1086	1111
962	987	1012	1037	1062	1087	1112
963	988	1013	1038	1063	1088	1113
964	989	1014	1039	1064	1089	1114
965	990	1015	1040	1065	1090	1115
966	991	1016	1041	1066	1091	1116
967	992	1017	1042	1067	1092	1117
968	993	1018	1043	1068	1093	1118
969	994	1019	1044	1069	1094	1119
970	995	1020	1045	1070	1095	1120

1021 1046 1071 1096 1121

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1123	1149	1175	1201	1227	1253	1279
1124	1150	1176	1202	1228	1254	1280
1125	1151	1177	1203	1229	1255	1281
1126	1152	1178	1204	1230	1256	1282
1127	1153	1179	1205	1231	1257	1283
1128	1154	1180	1206	1232	1258	1284
1129	1155	1181	1207	1233	1259	1285
1130	1156	1182	1208	1234	1260	1286
1131	1157	1183	1209	1235	1261	1287
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1133	1159	1185	1211	1237	1263	1289
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1135	1161	1187	1213	1239	1265	1291
1136	1162	1188	1214	1240	1266	1292
1137	1163	1189	1215	1241	1267	1293
1138	1164	1190	1216	1242	1268	1294
1139	1165	1191	1217	1243	1269	1295
1140	1166	1192	1218	1244	1270	1296
1141	1167	1193	1219	1245	1271	1297
1142	1168	1194	1220	1246	1272	1298
1143	1169	1195	1221	1247	1273	1299
1144	1170	1196		1248	1274	1300
1145	1171	1197	1223	1249	1275	1301
1146	1172	1198	1224	1250	1276	1302
1147	1173	1199	1225	1251	1277	1303
1148	1174	1200	1226	1252	1278	1304

1305	1330	1355	1380	1405	1430	1455
1306	1331	1356	1381	1406	1431	1456
1307	1332	1357	1382	1407	1432	145
1308	1333	1358	1383	1408	1433	1458
1309	1334	1359	1384	1409	1434	1459
1310	1335	1360	1385	1410	1435	1460
1311	1336	1361	1386	1411	1436	146
1312	1337	1362	1387	1412	1437	146
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1316	1341	1366				146
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1328						
1329	1354	1379	1404	1429	1454	1479

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	0			243	STARGATE TECHNOLOGIE
133	QUA TECH INC	230	800-553-1170	191	STARTECH INT'L
227	QUALSTAR CORP	259	818-882-5822	255	STARTEK
525-526	QUANTUM CORP (INT'L)	218	+41-38-337722	140	STATSOFT
	QUANTUM CORP (INT'L)	219	+41-38-337722	-	STRADA AUTOTECH, INC
132	QUARTERDECK OFFICE SYS	131	310-392-9851	535	SUNRACE
				163	SUNSOFT
	R			157	SYMANTEC
	RAIMA CORP	58	800-327-2462	143-144	SYSTAT INC
134-135	RAINBOW TECHNOLOGIES	61	800-852-8569		-
199	RALIN WHOLESALERS	249	716-674-2108*		1
193-194	RECORTEC INC	239	800-729-7654	231	TALKING TECHNOLOGY IN
136	ROSE ELECTRONICS	204	800-333-9343	232-233	TECHNOLOGIC SYSTEMS
				519	TECHPOWER COMPANY LT
	S			145	TEKTRONIX
530-531	SAMTRON	48IS-4	+82-2-774-6659*	146	TEXAS INSTRUMENTS
228	SAS INSTITUTE INC	261	919-677-8000	147	TEXAS INSTRUMENTS
171-172	SCEPTRE TECHNOLOGIES	107	800-788-2878	241	THE BSE COMPANY
229-230	SECURE IT INC	259	800-451-7592	148	TOSHIBA AMERICA INC
517	SEKISUI CHEMICAL CO LTD	112IS-4	+81-6-365-4375*	192	TOTE-A-LAP
137	SEQUITER SOFTWARE INC	132	403-437-2410	200	TRANSCEND INFORMATION INC
	SIGMA TECH SOFTWARE	254	818-368-6132	239	TRANTOR SYSTEMS LTD
176	SOFTARC	116	416-754-1856*	240	TRI VALLEY TECHNOLOGY
518	SOFTLINE CORP (INT'L)	CIII	718-438-2315*		TRIBAL MICROSYSTEMS
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TALY
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A-Z International Sales Ltd.
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London NW1 8AN
England
Tel: +44 71 2843171
FAX: +44 71 2843174

Dan Ehrlich
Ehrlich Communication Int'l.
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Herzliya 46101, Israel
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SINGAPORE

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Derek Ng
Stephen Tay
Third Wave Publishing Corp.
1123 Serangoon Road, #03-01
Singapore 1232
Tel: +65 296 6166 FAX: +65 298 7551

HONG KONG

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Third Wave Publishing Corp.
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82-84 To Kwa Wan Road
Kowloon, Hong Kong
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The Cuckoo's Egg Revisited

Five years ago, a hacker broke into a computer at Lawrence Berkeley Laboratory and changed the computing world forever

'm an astronomer. Five years ago, I found a 75-cent accounting error in my computer. It's curious how trivial errors are often ripe grounds for research. I traced it back to a programmer in Germany who broke into computers, stole data, and sold it to the KGB. Zooks—I'd stumbled onto a spy.

What's happened since then? The cold war has ended, the KGB dissolved, and Germany reunited. That computer spy, since convicted of espionage, has returned to programming. I told my story in *The Cuckoo's Egg*—perhaps the first book to combine espionage, computing, and chocolate chip cookies.

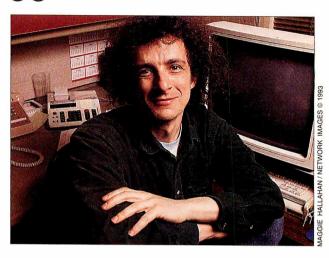
Meanwhile, the Internet has thrived. Five years ago, I counted 60,000 nodes; today, it's more like a million. Happily, worries of spies, viruses, and worms haven't hindered its growth: It doubles every year. It now transfers data and E-mail for academics, commercial groups, and, well, ordinary people. It taps a vast resource of software archives and passes thousands of messages an hour.

Our Internet has grown far beyond the cables that carry data. It's a worldwide community, a neighborhood built on ether. Can it ever go back to the tight-woven neighborhood it once was? No more than a city can return to its rural roots.

Events have conspired to create national policies that are confused, pulling at once toward privacy, openness, and secrecy. The holes in system security that intruders exploited in 1987 have long since been corked. In their place, new problems have arisen. Brute-force password decryption once took a week on a VAX; today's optimized cracking programs might take an afternoon. PC LANs create insecure environments that go undetected until they're tied to nationwide networks.

Meanwhile, the National Security Agency, trying to control cryptography, discourages companies from creating better locks for data. The Secret Service, under the computer security laws, has raided small-time computer hackers. A steady stream of break-in reports keeps the Computer Emergency Response Team hopping, one of the important results of the Internet Worm of 1988.

And the hacker underground has grown. Cyberpunks, often taking aim at phone systems and computer networks, have tweaked noses but haven't become the menace predicted five years ago. Break-ins are now routinely tracked across national borders. Curiously, the virus fad is fading. Hard to say why: It might be due to better antivirals, smarter users, or fewer scare stories.



The Cuckoo's Egg has been misused to justify busts of innocuous BBSes, restrictive legislation, investigations into networked activity, and who knows what monitoring by Big Brother. It's also been misused as a cookbook and as a justification by bad guys to break into computers. I disagree with all of these. I strongly disagree.

I've repeatedly testified before Congress and state legislatures. I don't want to lose the friendly sandbox that our networks have become. Our civil rights—including free speech and privacy—must be preserved on the electronic frontier.

Our computers show the tension between privacy and openness. Each of us wants governmental data to be public and open—there's no reason why we shouldn't be able to search governmental databases electronically. Yet we want data about ourselves—medical, financial, and personal records—to be kept secret and unavailable.

At the same time, we must respect each others' rights to privacy and free speech. This means not writing viruses, breaking into another's computer, or posting messages certain to cause flame wars. Just as important, it means treating each other with civility, respect, and tolerance. Our networks are communities, neighborhoods built on mutual trust.

Me? Oh, I'm now returning to astronomy and writing a book about telescopes—back to my roots. I subscribe to BYTE and pay all my shareware fees. You'll find me on CompuServe, AOL, GEnie, BIX, Usenet, and the Internet...often reading, occasionally posting.

And if someone breaks into my computer again? Oh, I doubt I'll bother. The first time it's research. The second time is just engineering.

Clifford Stoll graduated from Buffalo Public School #61 with a blue star for good attendance. Later, he repaired pinball machines, printed T-shirts, and received a Ph.D. in planetary science. In his spare time, he bicycles, makes plum jam, and squeezes lumps of bituminous coal into diamonds. You can contact him on BIX as "cliffstoll" or on the Internet at stoll@ocf.berkeley.edu.

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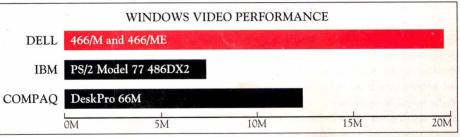


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